MODELLING AND SCALE-UP OF INDUSTRIAL CATALYTIC FLUIDIZED BED REACTORS

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PREFACE

The fundamental problem involved in the design of a gas-solid catalytic reactor is defining the reactant gas concentration as a function of position within the reactor. For fluidized bed reactors, the problem becomes very difficult because the gas flow is split into two distinct phases: a fast moving bubble phase that largely bypasses the catalyst and a slower moving dense or emulsion phase that surrounds the catalyst. For fluid beds, the design problem becomes one of defining the concentration of the reactant in the emulsion phase as a function of position, determining the fraction of the total gas in the emulsion phase and closely estimating the transfer of reactant by mass transport between the bubble and emulsion phases. This interphase transport is a function of the bubble size.

The Bubble Assemblage model proposed by Kato and Wen is one of the better models and it solved many of the problems associated with the constant bubble size models used in earlier work. However, this model has several insufficiencies. The first weakness in the Kato-Wen Bubble Assemblage model lies in the assumption that the percolation of gas through the dense phase can be neglected. This treatment consistently results in low estimates of the overall conversion in a fluidized bed reactor, especially in a bed of large fast bubbles where a substantial fraction of the gas flows through the emulsion phase. The second inadequency of the Kato-Wen model is that complete mixing is assumed in each phase, which results in overestimation of the overall conversion in the bed. The third insufficiency of the model is that it neglects the effect of reactor diameter on bubble velocity which is an important factor in the design of a fluidized bed reactor. The last insufficiency of the Bubble Assemblage model is the inclusion of a cloud volume within bubbles which is very small under the normal industrial operating conditions.

A new fluidized bed reactor model is developed in order to resolve the design problems mentioned above. The new model's basis is a different assumption regarding gas mixing in each compartment. The height averaged concentration in each phase which is a new concept regarding the gas mixing is included in the new model. The height averaged concentrations are predicted using the non-uniform spaced Euler method. In this new model, the average fractions of bubble and emulsion in each compartment are allowed to vary in each cell along the bed. The new model also incorporated the most recent bubble velocity correlation.

Model predictions are in reasonably good agreement with experimental results which were obtained under the operating conditions, $U_{mf} > 0.5$ cm/s. The present study also presents a suggested method for the prediction of emulsion gas

voidage in a fluidized bed.

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NOMENCLATURE

A	bubble frequency at the distributor, no. of bubbles/sec
A_t	cross-sectional area of the fluidized bed, cm^2
B	factor defined by Eq (7) in Appendix A or constant in Eq (10)
C_o	initial gas concentration in the fluidized bed, $gmole/cm^3$
C_{BO}	initial gas concentration in the bubble phase, $gmole/cm^3$
$\hat{C}_{Bn}$	height averaged bubble concentration defined by Eq (21)
C_E	gas concentration in the emulsion phase, $gmole/cm^3$
C_{EO}	initial gas concentration in the emulsion phase, $gmole/cm^3$
$\hat{C}_{En}$	height averaged emulsion concentration defined by Eq (17)
C_N	gas concentration leaving the fluidized bed, $gmole/cm^3$
C_n	gas concentration leaving the n^{th} compartment, $gmole/cm^3$
D_B	bubble diameter, cm
D_{BO}	intial bubble diameter, cm
D_{BM}	maximum bubble diameter, cm
D'_{Bn}	bubble diameter at $h=h_n$, cm
D_t	reactor diameter, cm
d_p	diameter of the fluidized solid particle, g/cm^3
EMF	computer output of ϵ_n
f	bubble frequency, no. of bubbles/sec
f_w	ratio of volume of wake to volume of bubble

g	gravitational acceleration, 980 cm^2/sec
Hn	computer output of h_n
HHT	computer output of h'_n
h	vertical height from distributor plate, cm
h_o	constant characteristic of the distributor, cm
Δh_1	height of the first compartment, cm
h_n	height at the middle of the n^{th} compartment from the distributor, cm
h'_n	height of the boundary between $n-1^{st}$ and n^{th} compartment from the distributor, cm
Δh_n	height of the n^{th} compartment, cm
k	reaction rate constant, 1/sec
K_{BE}	gas interchange coefficient, 1/sec
K_{ben}	gas interchange coefficient in the n^{th} compartment, 1/sec
k_v	velocity coefficient
L_f	expanded bed height, cm
L_{mf}	bed height at minimum fluidization, cm
N	total number of compartments
N_b	number of bubbles
N_D	total number of holes in the perforated plate
n	number of the n^{th} compartment
Q	visible bubble flow, cm^3/cm^2sec
Q_b	gas volumetric flow rate through the bubble phase, cm^3/sec
Q_e	gas volumetric flow rate through the emulsion phase, cm^3/sec
Q_T	total volumetric gas flow rate, cm^3/sec
r_A	reaction rate per unit volume of catalyst, gmole/sec cm^3

S cross-sectional area of bed, cm^2

U_o superficial gas velocity, cm/sec

U_B bubble rising velocity, cm/sec

U_{Bn} bubble rising velocity in the n^{th} compartment, cm/sec

U_e gas velocity through the emulsion phase, cm/sec

U_{mf} minimum fluidization velocity, cm/sec

V_B bubble volume, cm^3

X overall conversion

X_{exp} experimental overall conversion

Y coefficient defined by Eq (43)

z vertical height from distributor plate, cm

Greek symbols

δ average bubble voidage

δ_n average bubble voidage in the n^{th} compartment

ϵ_e emulsion void fraction

ϵ_f average bed voidage

ϵ_{mf} voidage at mimimum fluidization

ϵ_n average bed voidage in the n^{th} compartment

ρ_g gas density, g/cm^3

ρ_s average solid density, g/cm^3

ψ coefficient defined by Eq (9)

CHAPTER I

INTRODUCTION

Fluidized-bed reactors are used widely for many industrial processes (1). They have certain advantages over other gas-solid reactors which include ease of solids handling, which is particularly important where rapid catalyst fouling occurs, good heat transfer characteristics, and essentially isothermal operation (2). However, in spite of their wide use in industry, the design and scale-up of a commercial size fluidized-bed reactor is still based on a more or less empirical basis and information obtained from building a sequence of progressively larger reactors. This procedure not only has proven to be costly and time consuming but also has led to overdesigning and delaying the development of the processes. Most scale-up information produced in this manner is considered proprietary information by industry and is not available in the open literature.

Over the past two decades, an enormous amount of work has been carried out on the development of a reliable model which will represent the performance of the reactor under a wide range of operating conditions. Unfortunately, due to the complexity of the phenomena involved as well as problems in determining the relevant parameters, such as bubble sizes and velocities, none of the models proposed so far is adequate for designing a commercial-sized fluid bed reactor with sufficient confidence to eliminate pilot plant use (3), (4).

The two phase theory of fluidization expounded by Toomey and Johnstone (5) forms the basis of many of the models but in recent years a large number of experimental studies show that the two-phase theory overestimates the visible bubble flow, in some cases by a considerable amount (6). In other words, a larger quantity of gas flows through the emulsion phase than is predicted by the two phase theory.

Another inadequency of the two phase models developed earlier (7),(8) was the failure to include the bubble coalescence. They use the gas bubbles as the means of relating the model parameters to operating conditions. Thus, an average bubble size, which is often estimated at the middle point in the bed, becomes the key parameter. Although this approach could be used successfully in some cases, there are a number of problems associated with it. In the first place, use of an average bubble size cannot adequately describe the complete bed where bubbles are present in varying size, undergo growth and coalescence as they rise. Another problem with the approach of a constant bubble size is its failure to deal with the flow reversal of gas in the emulsion phase, which occurs when the gas velocity is much higher than the minimum fluidization velocity.

In 1969, Kato and Wen (9) proposed the bubble assemblage model to solve the design problems associated with the constant bubble size approach. In this model, the bubbling bed is divided into N compartments in series, the height of each compartment being equal to the bubble diameter at the corresponding bed depth. In each compartment, the gas in the two phases is considered to be completely mixed. In 1982, Peters and co-workers (10) combined the bubble assemblage concept of Kato and Wen and the three-phase model of Fryer and Potter (11) to provide a more realistic description of a gas-solid fluidized bed reactor.

Although the bubble assemblage concept certainly contributed considerably to the understanding of fluidized bed behavior, the assumptions they made regarding the degree of gas mixing in each phase represent a gross oversimplification of the real situation. It is known experimentally that the gas concentration in each phase varies along the bed height (12)-(15).

Axial mixing of emulsion phase gas in a fluid-bed is strongly influenced by the gross circulation of solid particles (16) and the adsorption processes (17). Whether or not solids are well mixed is strongly dependent on whether the bubble flow is distributed uniformly over the cross-sectional area of the bed. On the industrial scale however where gas may be introduced into a bed through regularly distributed but discreet entry points (nozzles, tuyeres, etc) there is always the possibility that bubbles will rise along preferred paths and regular solid circulation patterns will be established, thereby inhibiting complete radial mixing.

As indicated previously, the development of a reliable fluidized-bed model requires the correct division of reactant gas entering to a fluidized bed. In other words, it is very important to estimate average voidage occupied by bubbles. The velocity of the bubble is one of the key parameters for the estimation of average bubble voidage. Kato and Wen used the Davidson model (8), the commonly accepted correlation at that time, for the estimation of bubble velocity and Peters and coworkers also used the same correlation. However, in 1978, Werther proposed a new bubble velocity correlation which included the effect of both the reactor diameter and bubble size (18).

The purpose of the present work is to modify the bubble assemblage model to obtain a more general treatment of a fluidized bed reactor. The basis is a different assumption regarding gas mixing in each compartment. The compartment height is taken as equal to an equivalent spherical diameter for a bubble. In this new model, the average fractions of bubble and emulsion phase in each compartment are allowed to vary in each cell along the bed. The average reactant concentration of each phase in each cell is defined as the summation of all concentrations along each cell height divided by the cell height. The average concentration will be calculated by a non-uniform spaced Euler method (19). The new model will also incorporate the new bubble velocity correlation proposed by Werther which takes into account the effect of bed diameter and bubble size.

The experimental data available in literature on first order catalytic reaction systems in fluidized beds are used to test the validity the proposed model.

CHAPTER II

LITERATURE REVIEW

The literature review will cover the following subjects:

1. Bubble Size and Growth
2. Bubble Velocity
3. Average Bubble Voidage
4. Bed Expansion
5. Interphase Gas Exchange
6. Emulsion Gas Mixing
7. Previous Models

Bubble Size and Growth

Bubble size is one of the most important factors which govern the performance of a fluid-bed reactor. The mass transfer of gas between the bubble phase and the emulsion phase is a strong function of bubble size (20) and the prediction of bubble size is necessary for the calculation of chemical conversion in the bed. The properties of the bubbles in the bed are strongly dependent on the bubble size. These include bubble velocity and bubble voidage which determine the pattern of solid mixing in the bed. As a consequence of these effects, the size of the bubble is of primary importance in the scale-up of fluidized beds (18), (21).

However, the accurate prediction of bubble size is very difficult because of bubble growth and variation of its shape during the rise of bubbles through the bed. Bubble growth in fluidized beds occurs by three mechanisms: (a) the decrease in hydrostatic pressure as the bubble rises, (b) one bubble overtaking another vertically, and (c) one bubble combining with another horizontally (22).

Because of the importance of bubble growth in the prediction of fluidized bed performance, many correlations for bubble growth have been proposed; these correlations are reviewed in the paper by Mori and Wen (23). In general, they found that these correlations applied only at the specific conditions at which the data were taken. It was also noted that the bed diameter affects bubble growth. Mori and Wen proposed a semiempirical correlation that relates bubble diameter, bed diameter and initial bubble size as follows:

$$D_B = D_{BM} - (D_{BM} - D_{BO})\exp(-0.3h/D_t) \quad (1)$$

where h is the height of the bed measured from the distributor to the surface of the bed and D_{BM} is the maximum diameter of the bubble determined by bubble coalescence. The diameter D_{BM} is given by:

$$D_{BM} = 0.652(A_t(U_o - U_{mf}))^{0.4} \qquad (2)$$

The initial bubble diameter at the distributor plate also depends on the type of plate. The initial bubble diameter is calculated from equations, (3), (4), (5), (6) shown below.

$$D_{BO} = 0.00376(U_o - U_{mf})^2 \qquad (3)$$

for porous distributor plates

$$D_{BO} = 0.347(A_t(U_o - U_{mf})/N_D)^{0.4} \qquad (4)$$

for perforated distributor plates and

$$D_{BO} = 1.5(U_o - U_{mf})^{0.26}, \text{ for } U_o < 4.0 \text{ cm/s} \qquad (5)$$

$$D_{BO} = 0.7(U_o - U_{mf})^{0.83}, \text{ for } U_o > 4.0 \text{ cm/s} \qquad (6)$$

for bubble cap (11).

The correlation is valid over the following bubble growth:

$0.5 < U_{mf} < 20$ cm/s

$0.006 < d_p < 0.045$ cm

$U_o - U_{mf} < 48$ cm/s

$D_t < 130$ cm

Bubble Velocity

The bubble rise velocity, U_B, of gas bubbles in fluid beds is an equally important factor in the design of a fluidized bed reactor. If U_B is much greater than the minimum fluidization velocity, U_{mf}, gas bypassing can occur and be a serious problem; if on the other hand $U_B < U_{mf}$, gas-particle contact can be good and the performance of the bed approximates plug flow.

However, the accurate prediction of the rise velocity is difficult because the velocity of bubbles is strongly influenced by the bubble size and growth as well as their shape. As mentioned previously, the methodology for predicting the bubble size distribution as a function of bed height has not yet been developed because of the complicated phenomenon involved in the bubble growth.

The studies on bubble rise velocity are numerous, among them the works of Davidson and Harrison (8), Rowe and Yacono (24), and Werther (18) are noteworthy. Davidson and Harrison developed a correlation based on theoretical grounds that the average velocity of a bubble in a swarm should be given by the natural rising velocity of an isolated bubble plus the upward velocity of the particulate phase between the bubbles:

$$U_B = U_0 - U_{mf} + 0.711(gD_B)^{0.5} \quad (7)$$

Although the validity of this equation is open to doubt, it is widely used in reactor design calculations (9),(10). Rowe and Yacono proposed a new bubble velocity correlation which takes into account the effect of particle size and distribution:

$$U_B = (U_0 - U_{mf}) + 0.0936\, k_v(h + h_0)^{1/8}(U_0 - U_{mf})^{1/4} \quad (8)$$

The coefficient k_v increases from about 1.0 for 260 micro-meter particles to 1.3 for those of 40 micro-meter, and h_o is a constant characteristic of the distributor, being approximately zero for a porous plate.

In 1978, Werther found that the velocity of a bubble is a function of the diameter of the reactor and is given by

$$U_B = \psi (gD_B)^{1/2} \tag{9}$$

where

$$\psi = \begin{cases} 0.64 & D_t \leq 10 \text{ cm} \\ 0.225(D_t)^{0.4} & 10 < D_t < 100 \\ 1.6 & D_t \geq 100 \end{cases}$$

and D_t is the diameter of the reactor.

Average Bubble Voidage

In developing the gas flow model, it is necessary to know the bubble volume fraction within the fluidized bed. The prediction of the bubble volume fraction requires information regarding bubble frequency or the number of bubbles per unit volume at some height, z, above distributor plate. Toor and Calderbank (25) showed that the bubble frequency, f, in the bed exponentially decreases with heights above the distributor:

$$f = A \exp(-Bz) \tag{10}$$

where A and B are constants which must be determined experimentally. However, the validity of Eq. (10) is doubtful even though this two-parameter exponential equation is sometimes using for the predicting of the average bubble voidage in the bed.

The most accepted methodology for predicting bubble voidage in the fluidized bed is described in detail in the book written by Kunii and Levenspiel (26). They computed bubble voidage, δ, from the average bed voidage, ϵ_f, and the bed voidage at minimum fluidizing conditions, ϵ_{mf}:

$$\delta = \frac{\epsilon_f - \epsilon_{mf}}{1 - \epsilon_{mf}} \qquad (11)$$

Equation (11) was derived based on the assumption that the emulsion void fraction, ϵ_e, remains equal to the void fraction at minimum fluidizing conditions, ϵ_{mf}.

However, when fine particles are fluidized by increasing gas velocities above the minimum fluidizing velocity, there is a region in which the bed expands without bubble formation (27). Therefore, the emulsion void fraction is expected to be greater than the minimum void fraction in the bed. Unfortunately, no accurate method for the prediction of emulsion void fraction is available in literature.

Kato and Wen showed that the average void fraction in the bed remains constant below the minimum fluidization bed height but above the minimum bed height exponentially increases (9).

Bed Expansion

When the superficial gas velocity through a fluidized bed is increased above the minimum fluidization velocity, the bed expands. This expansion is due to (a) the formation and coalescence of bubbles or voids of gas and (b) the expansion of the emulsion phase due to an increase in gas flow through this phase, which implies that the bed expansion is related to the bubble diameter and bubble growth. As mentioned in the part of introduction, the volumetric flux of the gas in the bubble phase has been observed to be smaller than that predicted by two phase theory. Therefore, the emulsion phase volumetric flux and expansion should be greater than is predicted by two phase theory.

The expanded bed height may be obtained experimentally for a given system, or estimated from an empirical correlation. Babu, Shah and Talwalker (28) proposed the following relation which was obtained by a statistical fit of available data:

$$\frac{L_f}{L_{mf}} = 1 + \frac{1.9544\,(U_0 - U_{mf})^{0.738} d_p^{1.006}\ \rho_s^{0.376}}{U_{mf}^{0.937}\ \rho_g^{0.126}} \qquad (12)$$

All terms are expressed in centimeter-gram-second (cgs) units. This correlation is based on data for reactor diameters between 6.35 and 30.5 cm. Another and more widely used empirical correlation was proposed by Peters, Fan and Sweeney (10).

$$\frac{L_f - L_{mf}}{L_f} = \frac{Y\,(U_0 - U_{mf})}{U_B \text{ at } z = 0.5L_{mf}} \qquad (13)$$

where

$$Y = 0.7585 - 0.0013\,(U_0 - U_{mf}) + 0.0005\,(U_0 - U_{mf})^2$$

Interphase Gas Exchange

Unlike gas bubbles in liquids, gas bubbles in fluidized beds have no coherent surface and no surface tension force surrounds the bubbles. Therefore, it is possible for gas within a bubble to flow through the interstices between the particles and to exchange with gas in the emulsion phase of the bed. This exchange will have an important influence on the extent of gas-solid contact and hence on the level of chemical conversion, and it represents a major factor in any model of a reacting fluidized bed system.

The gas interchange between the bubble phase and emulsion phase is (a) due to direct interchange of gas in bubbles and in emulsion and (b) indirect interchange due to adsorbed gas on the surface of interchanging particles.

The studies of interchange gas exchange are numerous, among them the works of Sit and Grace (29), Chiba and Kobayashi (30), and Kobayashi, Arai and Sunagawa (31) are noteworthy. Sit and Grace showed that an overall gas exchange for a spherical bubble was made by the convective and diffusive mechanisms. They showed that the throughflow term becomes dominant for large particles while the diffusive term is rate-controlling for small particles. Chiba and Kobayashi studied the effect of adsorption on the interphase exchange in a fluid bed. Kobayashi et al (31) proposed a following correlation based upon their experimental work.

$$K_{BE} = \frac{11}{D_B} \tag{14}$$

where D_B is average bubble diameter.

Emulsion Gas Mixing

The gas flow through a bed at the point of incipient fluidization (or minimum fluidization) approximates closely plug flow because of low Reynolds numbers based on particle diameters. Therefore, the gas may be pictured as percolating between the more-or-less stationary particles with little tendency to backmix. However, as the gas velocities increase, bubbles form and bed solids are moved about in their wakes. As a result, axial mixing of emulsion phase gas occurs and the degree of mixing is influenced by adsorption (17).

Stephens et al (32) were first to investigate the backmixing caused by bubbles. Kunii and Levenspiel (33) showed that the upward flow of solids in cloud wakes is compensated for by a corresponding downward flow of solids in the emulsion phase.

Previous Models

Most of the models which have been developed are based on the two phase theory originally proposed by Toomey and Johnstone (5). However, they differ considerably in the assumptions they make regarding the exact nature of the phases, the mode of interphase gas exchange, and the degree of gas mixing in the phases. Review papers of the models are available (4), (13). The models fall into one of two categories: (a) simple two phase models based on empirical correlations obtained with small scale equipment, (b) models based on bubble dynamics which describe reactor behaviour in terms of the known physics and hydrodynamics of fluid beds.

In the absence of bubbles, a fluidized bed can be treated as a plug flow reactor. However, in the presence of bubbles, rapid axial mixing of the solids occurs and this treatment is unrealistic (34).

The two phase models considered earlier use the gas bubbles as the means of relating the model parameters to operating conditions. Thus, an average bubble size, which is often estimated at the middle point in the bed, becomes the key parameter. The bubble size is often considered as an adjustable parameter in the absence of bubble size information. Although this approach could be used successfully in some cases, there are a number of problems associated with it. In the first place, use of an average bubble size cannot adequately describe the bed since bubbles are present in varying sizes, undergo growth and coalescence as they rise. Another problem with the constant bubble size approach is its inability to deal with the flow reversal of gas in the emulsion phase, which occurs when the gas velocity is much higher than the minimum fluidization velocity.

Kato and Wen (9) proposed a bubble assemblage model. In this model, the bubbling bed is divided into N compartments, each equal in height to the bubble diameter at the corresponding bed depth. In each compartment, the gas in the two phases is considered to be completely mixed, and the interphase exchange coefficient is given by equation (14).

Peters and co-workers (10) combined the bubble assemblage concept of Kato and Wen with the three-phase model of Fryer and Potter (11) to advance a cell model in which an equivalent spherical diameter for a bubble is the cell size. In this model, the concept of local flow reversal of emulsion phase gas and emulsion phase de-gassing coefficients was introduced.

The weakness in the above Kato-Wen model lies in the assumption that the percolation of gas through the dense phase can be neglected. This treatment consistently results in underestimation of the overall conversion in a fluidized bed reactor, especially in a bed of large fast bubbles where a large amount of gas flows through the emulsion phase. On the other hand, under the operating conditions of industrial fluid bed catalytic reactors where gas velocities, U_0, are substantially greater than the minimum fluidizing velocity, U_{mf}, a cloud volume within bubbles is so small that the three phase treatment of the above Peters and coworkers is expected to be unrealistic (7).

Besides those insufficiencies, both models use bubble and emulsion concentrations entering each compartment that is smaller than the height averaged bubble and emulsion concentration of the previous compartment (13), (15). Therefore, this kind of treatment results in overestimation of the overall conversion in the bed.

CHAPTER III

MODEL DEVELOPMENT

The development of the present model is based upon the following simplifying assumptions,

(1). A fluidized bed may be represented by N numbers of compartments in series (9). Each compartment is considered to be composed of a bubble and an emulsion phase. The size of each compartment, which varies throughout the fluidized bed, is based on the diameter of the bubbles at a given bed height.

(2). All particles are assumed to be in the dense phase that occupies a fraction, $1-\delta$ of the bed (δ is the fraction of bed occupied by bubbles).

(3). The outlet concentration of each compartment may be determined by the inlet concentration and properties of each compartment.

(4). Although the properties such as average voidage, average bubble voidage, gas exchange coefficient, and bubble velocity vary continuously throughout each compartment, a single value of each property can be used to represent the compartment.

(5). The representative value of each property can be determined at the midpoint height of each compartment because the property is assumed to be linear.

Figure 1 shows the schematic diagram of the proposed model as well as the notation employed. The general material balance equation can be written over the n^{th} compartment.

Input - Output = Amount of reactant used by a reaction

$$SU_o(C_{n-1} - C_n) = (-r_A)\Delta h_n S(1 - \epsilon_n) \qquad (15)$$

where

$$-r_A = k\hat{C}_{En} \qquad (16)$$

and

$$\hat{C}_{En} = \frac{\int_{h'_n}^{h'_{n+1}} C_E dz}{\Delta h_n} \qquad (17)$$

Then,

$$C_n = C_{n-1} - NR_n \hat{C}_{En} \qquad (18)$$

where

$$NR_n = \frac{\Delta h_n (1 - \epsilon_n) k}{U_o} \qquad (19)$$

Next, if we define δ_n as the volume fraction of bubbles in the n^{th} compartment, the outlet concentration of a reactant from the n^{th} compartment can be determined by the following equation (10), (15).

$$C_n = \delta_n \hat{C}_{Bn} + (1 - \delta_n)\hat{C}_{En} \qquad (20)$$

where $\hat{C}_{Bn}$ is defined as follows,

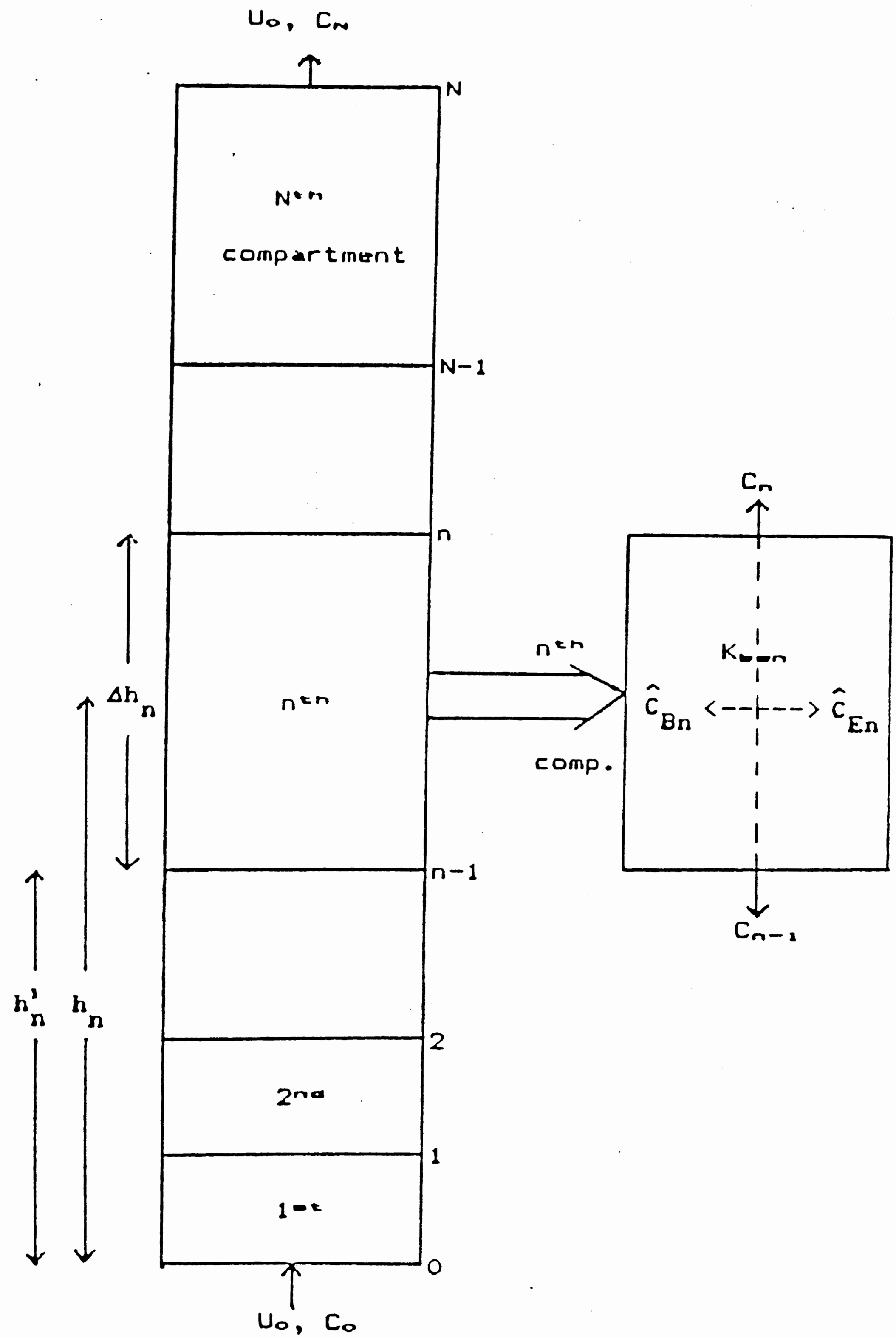

Figure 1. Schematic Diagram of the Proposed Model
as well as the Notation employed

$$\hat{C}_{Bn} = \frac{\int_{h'_n}^{h'_{n+1}} C_B dz}{\Delta h_n} \tag{21}$$

and $\hat{C}_{En}$ is given by Eq (17).

Here, let's consider a mass balance on a reactant moving through the bubble phase in the n^{th} compartment. The following simplifying assumptions are made,

(1). Steady state

(2). Gas is plug flow in the bubble phase; hence the back diffusion terms vanish,

and (3). No reaction occurs in the bubble phase.

Then, the following equation can be written.

$$\frac{d\hat{C}_B}{dz} = -\frac{K_{be}}{U_B}(\hat{C}_B - \hat{C}_E) \tag{22}$$

Here, the height averaged concentrations, $\hat{C}_B$ and $\hat{C}_E$ are assumed to be equal to concentrations at a midpoint of each compartment,

$$\hat{C}_{Bn} = C_B \text{ at } h_n \tag{23}$$

$$\hat{C}_{En} = C_E \text{ at } h_n \tag{24}$$

By the Euler method (19), the height averaged bubble concentration in the n^{th} compartment can be expressed as follows,

$$\hat{C}_{Bn} = \hat{C}_{Bn-1} - \left(\frac{\Delta h_{n-1} + \Delta h_n}{2}\right)\left(\frac{K_{ben-1}}{U_{Bn-1}}\right)(\hat{C}_{Bn-1} - \hat{C}_{En-1}) \qquad (25)$$

$$\hat{C}_{Bn} = (1 - Z_{n-1})\hat{C}_{Bn-1} + Z_{n-1}\hat{C}_{En-1} \qquad (26)$$

where

$$Z_{n-1} = \left(\frac{\Delta h_{n-1} + \Delta h_n}{2}\right)\left(\frac{K_{ben-1}}{U_{Bn-1}}\right) \qquad (27)$$

Substitution of Equation (26) into Equation (20) gives,

$$C_n = \delta_n(1 - Z_{n-1})\hat{C}_{Bn-1} + \delta_n Z_{n-1}\hat{C}_{En-1} + (1 - \delta_n)\hat{C}_{En} \qquad (28)$$

and

$$\hat{C}_{En} = \frac{1}{1 - \delta_n}C_n - \frac{\delta_n}{1 - \delta_n}(1 - Z_{n-1})\hat{C}_{Bn-1} - \frac{\delta_n}{1 - \delta_n}Z_{n-1}\hat{C}_{En-1} \qquad (29)$$

Substitution of Equation (29) into Equation (18) and rearragement give,

$$C_n = \frac{1 - \delta_n}{\left(1 - \delta_n + NR_n\right)}C_{n-1} + \frac{\delta_n}{\left(1 - \delta_n + NR_n\right)}NR_n(1 - Z_{n-1})\hat{C}_{Bn-1}$$

$$+ \frac{\delta_n}{\left(1 - \delta_n + NR_n\right)} NR_n Z_{n-1} \hat{C}_{Bn-1} \qquad (30)$$

A solution for the axial concentrations in both phases is obtained from the bottom up, starting with the inlet conditions that specify the size of the first compartment. The solution for the first compartment is then used to calculate the next compartment size (equivalent bubble diameter) which allows solution of the mass balance equation for the second compartment. The procedures are repeated until the cumulative compartment height reaches the expanded bed height.

CHAPTER IV

ESTIMATION OF THE PARAMETERS OF THE MODEL

Size of Compartment

The estimation of average bubble diameter of each compartment is based on a correlation proposed by Mori and Wen (23). This correlation is characterized by the consideration of the effects of bed diameter and distributor type used.

$$D_B = D_{BM} - (D_{BM} - D_{BO})\exp(-0.3h/D_t) \tag{31}$$

where

$$D_{BM} = 0.652(S(U_0 - U_{mf}))^{2/5} \tag{32}$$

and

$$D_{BO} = 0.00376(U_0 - U_{mf})^2 \tag{33}$$

(for porous distributor plates)

$$D_{BO} = 0.347(S(U_0 - U_{mf})/N_D)^{2/5} \tag{34}$$

(for perforated distributor plates)

$$D_{BO} = 1.5(U_0 - U_{mf})^{0.26} \text{ for } U_0 < 4.0 \text{ cm/s} \tag{35}$$

$$D_{BO} = 0.7(U_0 - U_{mf})^{0.83} \text{ for } U_0 > 4.0 \text{ cm/s} \tag{36}$$

(for bubble cap)

This correlation is valid over the following variable ranges:

$0.5 < U_{mf} < 20$ cm/s

$0.006 < d_p < 0.045$ cm

$U_o - U_{mf} < 48$ cm/s

$D_t < 130$ cm

In the present model, the bed is divided into N compartments along the axial distance of the bed. Based upon an assumption made in chapter III, the n^{th} compartment has a height, Δh_n, equal to the diameter of the bubble. The height of n^{th} compartment, Δh_n, is determined by expanding D_B given by Equation (31), neglecting the terms after the second term, and calculating at h_n in a Taylor series about D'_{Bn} (35). Thus,

$$\Delta h_n = \frac{D'_{Bn}}{1 + 0.15(D'_{Bn} - D_{BM})/D_t} \qquad (37)$$

where D'_{Bn} is the bubble diameter at the boundary between $(n-1)^{st}$ and n^{th} compartment or $h=h'_n$. Here, h'_n is given by

$$h'_n = \sum_{i=1}^{n-1} \Delta h_i \qquad (38)$$

The bubble diameter at the n^{th} compartment is the diameter of the bubble at the middle of n^{th} compartment or at a height, h_n, given by

$$h_n = h'_n + \frac{\Delta h_n}{2} = \sum_{i=1}^{n-1} \Delta h_i + \frac{\Delta h_n}{2} \qquad (39)$$

The height of final compartment, Δh_N, is calculated by the following equation as,

$$\Delta h_N = L_f - h'_N \qquad (40)$$

where N is determined by the condition at which $h'_n + \Delta h_n$ becomes greater than L_f. At this position n is equal to N.

Linear Gas Velocity in the Bubble Phase

The linear gas velocity in the bubble phase may be computed by a equation proposed by Werther (18).

$$U_B = \Psi (gD_B)^{1/2} \qquad (41)$$

where

Ψ =	0.64	$D_t \leq 10$ cm
	$0.225(D_t)^{0.4}$	$10 < D_t < 100$ cm
	1.6	$D_t \geq 100$ cm

Expanded Bed Height

The bed expansion, L_f, is computed based on the following empirical correlation proposed by Peters et al (10).

$$\frac{L_f - L_{mf}}{L_f} = \frac{Y(U_o - U_{mf})}{U_B \text{ at } z = 0.5L_{mf}} \tag{42}$$

where

$$Y = 0.7585 - 0.0013(U_o - U_{mf}) + 0.0005(U_o - U_{mf})^2 \tag{43}$$

Average Void Fraction in Bed, ϵ_n

Gamma-ray studies of axial solids distribution in gas-solid fluidized beds show that the void fraction in the bed exponentially increases at heights above the minimum fluidization bed height. The average void fraction may be computed by a correlation proposed by Kato and Wen (9).

$$1 - \epsilon_n = \frac{L_{mf}}{L_f}(1 - \epsilon_{mf}) \qquad \text{for } h < L_{mf} \tag{44}$$

$$\frac{L_{mf}}{L_f}(1 - \epsilon_{mf})\exp\left(- \frac{h - L_{mf}}{L_f - L_{mf}}\right) \qquad \text{for } h > L_{mf} \tag{45}$$

Volume Fraction of Bubble Phase, δ

In order to compute the volume fraction of bubble phase, we have to estimate the number of bubbles in a compartment. With the compartment height based on the diameter of the bubble, the number of bubbles, N_b is computed by the method suggested by Kato and Wen (9).

$$N_b = \frac{6S(\epsilon_n - \epsilon_{mf})}{\pi D_B^2 (1 - \epsilon_{mf})} \tag{46}$$

Then, the volume fraction of the bubble may be computed as

$$\delta = \frac{V_B}{SD_B} \tag{47}$$

where

V_B = bubble volume

$$= N_b \left(\frac{\pi}{6} \right) D_B^3 \tag{48}$$

Gas Exchange Coefficient, K_{be}

The gas exchange coefficient, K_{be}, is computed based on the following experimental equation proposed by Kobayashi et al (31).

$$K_{be} = \frac{11}{D_B} \qquad (49)$$

CHAPTER V

CODE INPUT-OUTPUT AND COMPUTATIONAL METHOD

The computational procedure for conversion and concentration profile in a fluidized reactor is given in Figure 2 when the operating conditions such as: superficial gas velocity, U_o; minimum fluidization, L_{mf}; void fraction at minimum fluidization, ϵ_{mf}; column diameter, D_t; distributor arrangement; reaction rate constant, k; factor, ψ ; and the inlet concentration, C_o. There are no adjustable parameters in the present model.

First, Equation (32) is used to calculate the maximum bubble diameter. Next, Equations (33)-(36) are used to compute the initial bubble diameter, depending on the type of distributor. Using Equations (42) and (43), the expanded bed height L_f is then calculated. Based upon the calculated initial bubble diameter, the gas exchange coefficient K_{be}, and bubble velocity, U_b, in the first compartment are computed by using Equations (49) and (37). Next, the average void fraction in the first compartment is computed by using Equation (44), and the volume fraction of the bubble phase is calculated by Equations (46) and (47). Next, the gas concentration at $h=\Delta h_1$, C_1, is computed from the following simplifying assumption using Equation (30).

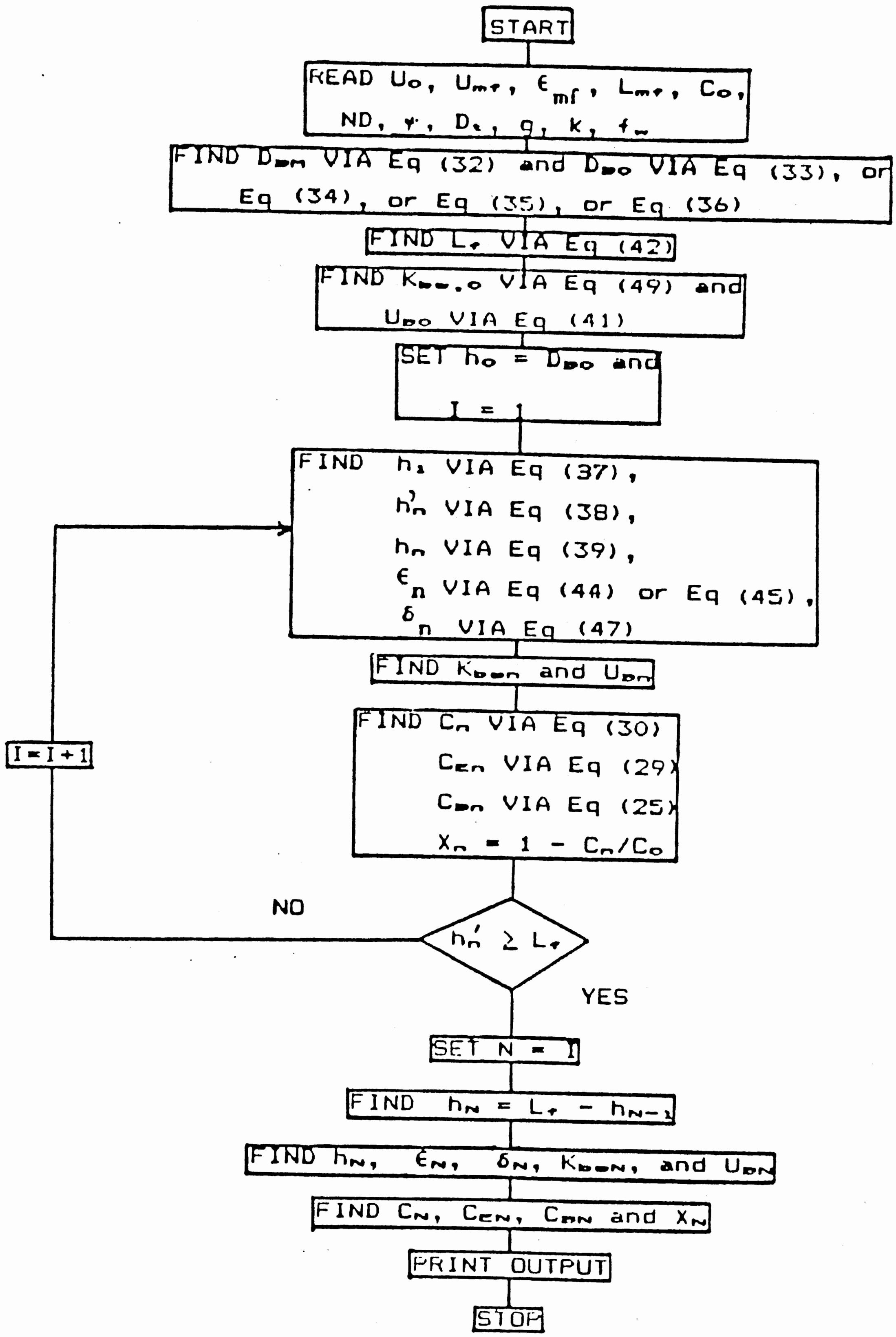

Figure 2. Flow Diagram for the Computational Procedure based on the Proposed Model

$$C_o = C_{Bo} = C_{Eo} \quad (50)$$

where C_o is the inlet concentration of reactant; C_{Bo} the inlet concentration of reactant in bubble phase; C_{Eo} the inlet concentration of reactant in emulsion phase.

Next, the height averaged concentrations in the first compartment, C_{E1} and C_{B1}, are computed by using Equations (29) and (26). The solution for the first compartment is then used to calculate the solution of the second compartment. The procedure is repeated until the cumulative compartment height given by Equation (38) reaches the expanded bed height, L_f, calculated previously by Equations (42) and (43).

The VAX 11/780 and VMS computer is used to compute the above computations.

CHAPTER VI

RESULTS AND DISCUSSION

The experimental data used to test the validity of the proposed model are shown in Table 1. As can be seen from Table 1, ozone decomposition by Fryer et al (36), Caderbank et al (37), Kobayashi et al (15) and Grace et al (12); ammonia oxidation by Massimilla et al (38); ethylene hydrogenation by Lewis et al (39) are employed here for that purpose. Table 2 shows results of the numerical solution obtained from the present model and the bubble assemblage model by Kato and Wen (9).

Division of Gas Flow between Phases

A partial verification of the present model for evaluating the volumetric gas flux through the bubble phase is shown in Figures 3-6. In Figures 3-6, the predicted visible bubble flow ,Q, as a function of the height from the distributor is compared to that of the two phase theory, U_0-U_{mf}. The predicted flux in the bubble phase is given by

TABLE 1

EXPERIMENTAL CONDITIONS OF DATA USED FOR THE VALIDITY OF THE MODEL

Authors	Reactions	D_t cm	Distributor	d_p cm	U_{mf} cm/s	k s^{-1}	U_o cm/s	L_{mf} cm
Fryer (36)	decomp. of ozone	22.9	bubble cap 61**	0.0117	1.7	0.330	2.17 ~ 10.1	23.1
Calderbank (37)	decomp. of ozone	45.7	porous plate	0.0192	3.73	0.029 ~ 1.248	5.75	99.1
Kobayashi (15)	decomp. of ozone	20.0	perforated 241***	0.0194	2.1	0.6	5.0 ~ 20.0	67.0
Grace (12)	decomp. of ozone	8.4*	perforated 9***	0.0215	5.3	0.1 ~ 0.2	10.0 ~ 21.4	130.0
Massimilla (38)	oxida. of ammonia	11.4	porous plate	0.0127	0.44	0.0446	3.4 ~ 14.3	58.0
Lewis (39)	hydrogen. of ethylene	5.2	screen	0.0122	0.31	0.93	4.8 ~ 35.0	42.0

* equivalent diameter
** number of bubble caps
*** total number of holes in the perforated plate

TABLE 1 (Continued)

Authors	ρ_g g/cm³	ρ_p g/cm³	Co gmole/cm³	ϵ_{mf}
Fryer (36)	0.0012	2.65	4.46×10^{-6}	0.48
Calderbank (37)	0.00129	2.619	8.035×10^{-7}	0.462
Kobayashi (15)	0.0013	2.2	2.23×10^{-6}	0.70
Grace (12)	0.0215	2.4	4.464×10^{-6}	0.41****
Massimilla (38)	0.00136	2.06	4.464×10^{-6}	0.41****
Lewis (39)	0.00114	0.513	4.46×10^{-6}	0.41****

**** estimated values

TABLE 2

CALCULATED CONVERSIONS AND EXPERIMENTAL CONVERSIONS

Data	k s^{-1}	U_o cm/s	$\frac{kL_{mf}}{U_o}$	Conversion Exp.	Kato-Wen	New model
Fryer	0.330	2.17	3.513	0.813	0.914	0.857
	0.330	2.67	2.855	0.647	0.872	0.793
	0.330	4.27	1.785	0.527	0.704	0.621
	0.330	4.80	1.588	0.420	0.587	0.574
	0.330	8.00	0.953	0.320	0.685	0.397
	0.330	10.13	0.753	0.273	0.661	0.326
Calderbank	0.029	5.75	0.500	0.227	0.530	0.237
	0.064	5.75	1.103	0.490	0.741	0.446
	0.122	5.75	2.103	0.620	0.866	0.670
	0.302	5.75	5.203	0.875	0.950	0.925
	0.668	5.75	11.508	0.930	0.990	0.992
	1.248	5.75	21.500	0.950	0.996	0.998
Kobayashi	0.6	5.0	8.040	0.910	0.973	0.977
	0.6	10.0	4.020	0.843	0.895	0.839
	0.6	15.0	2.680	0.779	0.841	0.707
	0.6	20.0	2.010	0.729	0.758	0.583

TABLE 2 (Continued)

Data	k	U_o	$\frac{kL_{mf}}{U_o}$	Conversion		
	s^{-1}	cm/s		Exp.	Kato-Wen	New model
Grace	0.1	10.0	1.300	0.72	0.667	0.747
	0.1	15.0	0.867	0.57	0.555	0.629
	0.1	21.4	0.607	0.45	0.438	0.536
	0.15	10.0	1.950	0.86	0.780	0.869
	0.15	15.0	1.300	0.73	0.679	0.769
	0.15	21.4	0.911	0.61	0.555	0.679
	0.20	10.0	2.600	0.92	0.846	0.931
	0.20	15.0	1.733	0.82	0.760	0.854
	0.20	21.4	1.215	0.70	0.640	0.775
Massimilla	0.045	3.4	0.761	0.52	0.705	0.346
	0.045	5.2	0.497	0.39	0.325	0.247
	0.045	7.9	0.327	0.30	0.605	0.171
	0.045	10.0	0.259	0.25	0.587	0.134
	0.045	14.3	0.181	0.18	0.514	0.100
Lewis	0.93	4.8	8.137	0.975	0.982	0.974
	0.93	9.3	4.200	0.944	0.868	0.847
	0.93	15.3	2.553	0.870	0.820	0.671
	0.93	19.3	2.024	0.819	0.788	0.576
	0.93	26.0	1.502	0.729	0.762	0.455
	0.93	35.0	1.116	0.625	0.702	0.348

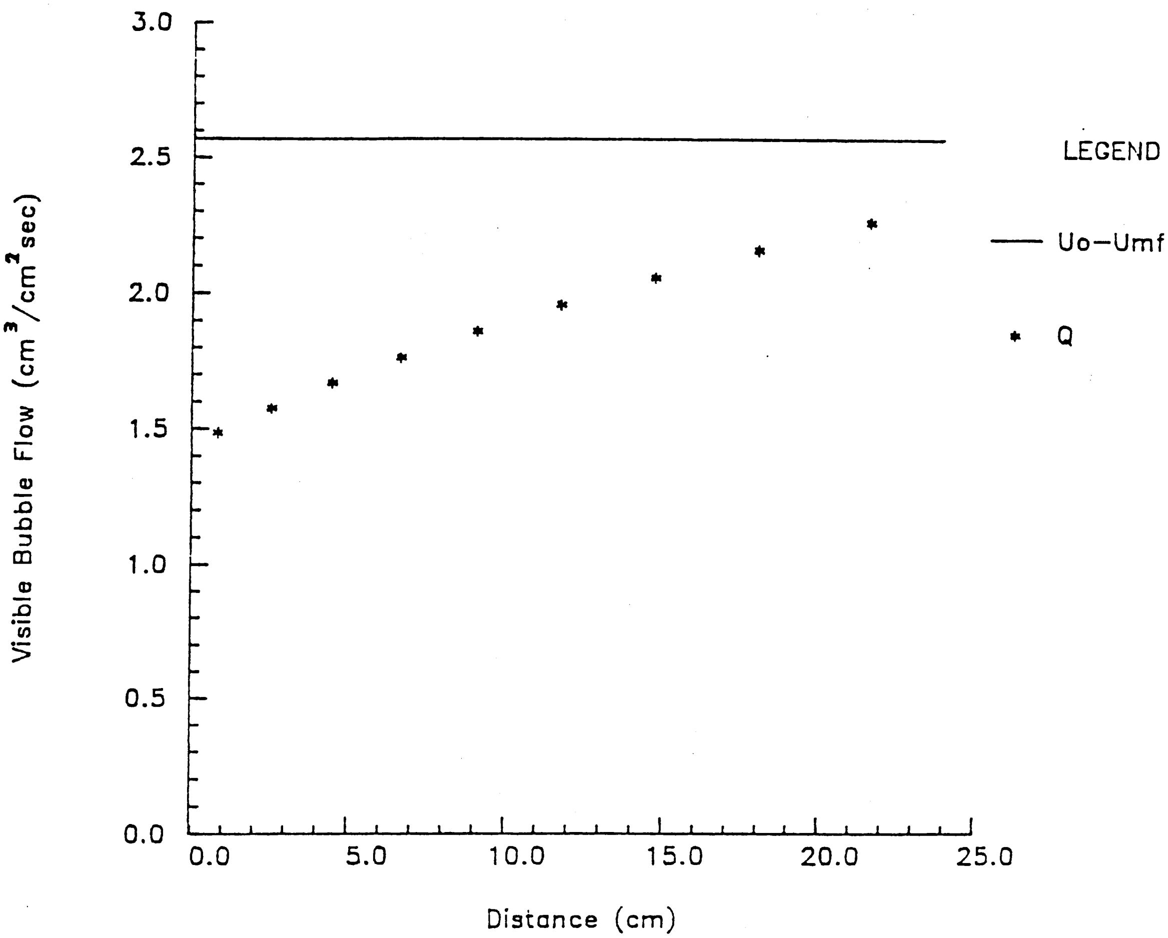

Figure 3. Comparison of the Visible Bubble Flow by Two Phase Theory and the Visible Bubble Flow used in the New Model (Fryer et al (36): Uo = 4.27 cm/s and k = 0.33 s^{-1})

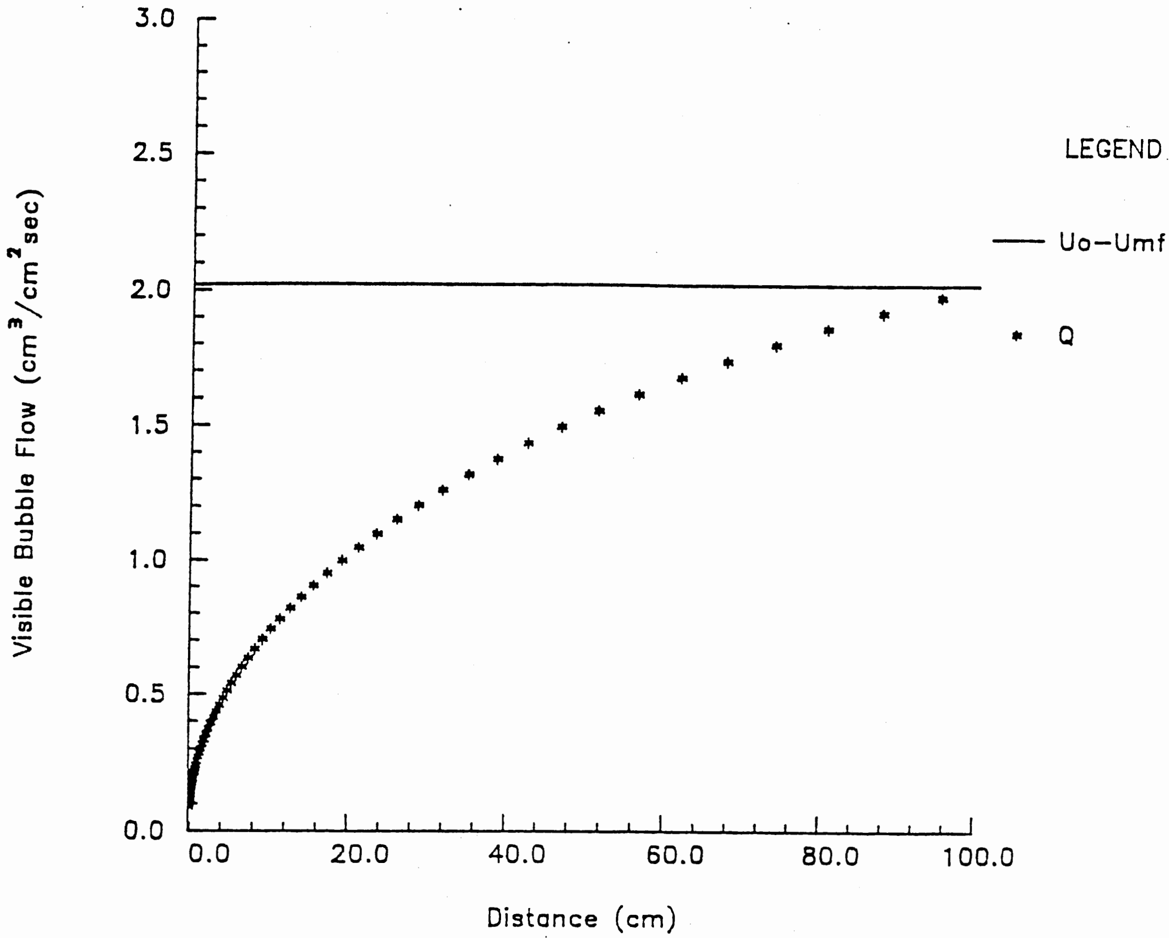

Figure 4. Comparison of the Visible Bubble Flow by Two Phase Theory and the Visible Bubble Flow used in the New Model (Calderbank (37): Uo = 5.75 cm/s and k = 0.029 s^{-1})

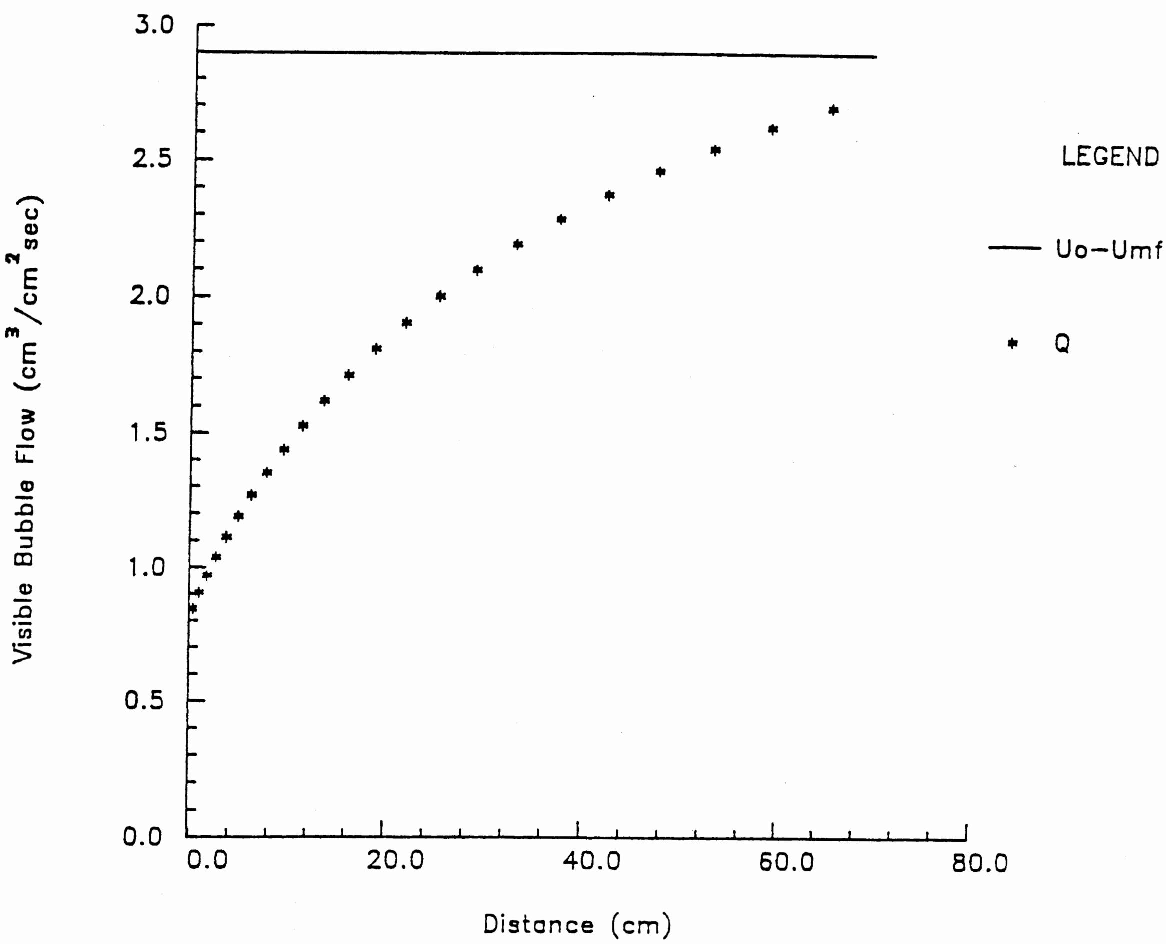

Figure 5. Comparison of the Visible Bubble Flow by Two Phase Theory and the Visible Bubble Flow used in the New Model (Kobayashi (15): U_o = 5.0 cm/s and k = 0.60 s^{-1})

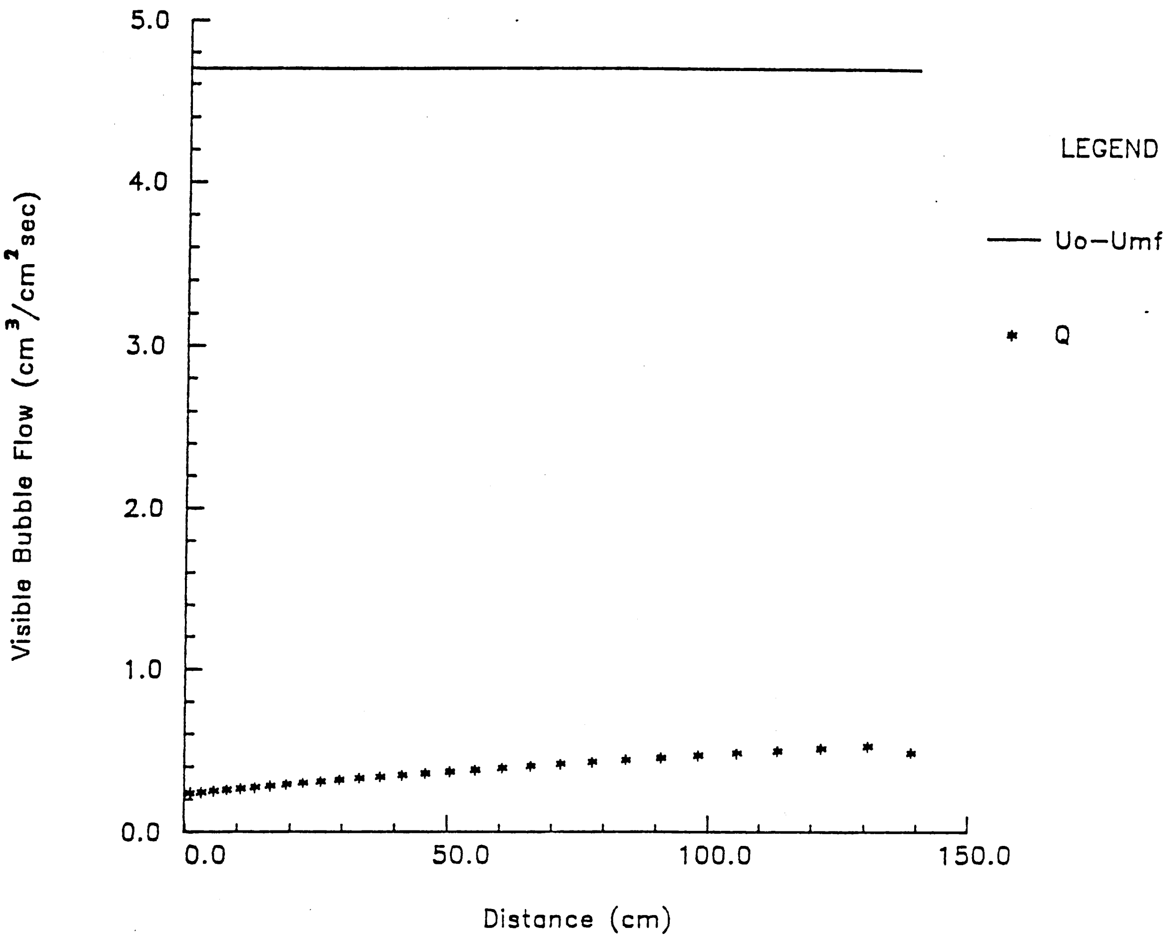

Figure 6. Comparison of the Visible Bubble Flow by Two Phase Theory and the Visible Bubble Flow used in the New Model (Grace (12): Uo = 10.0 cm/s and k = 0.10 s^{-1})

$$\frac{Q_b}{A} = U_B \ \delta \tag{51}$$

where Q_b is the gas volumetric flow rate through the bubble phase.

As can be seen from Figures 3-6, the predicted visible bubble flow is smaller by a considerable amount than that predicted by the two phase theory with experimental data for ozone decomposition. However, in case of the Massimilla and Lewis data an unreasonable trend is observing as shown in Figure 7. This failure may be attributed to the bubble growth correlation, and the assumptions made in the development of the present model. Their experimental conditions, especially U_{mf}, are out of the valid region for the bubble correlation used because the minimum fluidization velocity is smaller than 0.5 cm/s. Secondly under those experimental conditions the emulsion voidage is not believed to be equal to that of the bed at minimum fluidizing conditions.

In Figures 8-9, the experimental minimum fluidizing voidage as a function of the height from the distributor is compared to the voidage obtained by Eq (6) in Appendix A.

In Figure 8, which shows a typical trend of successfully fitted experimental data, the agreement is reasonable for the majority of points. However, in Figure 9, which shows a typical trend of the Massimilla and Lewis data, the agreement is clearly not as good due to the reasons men-

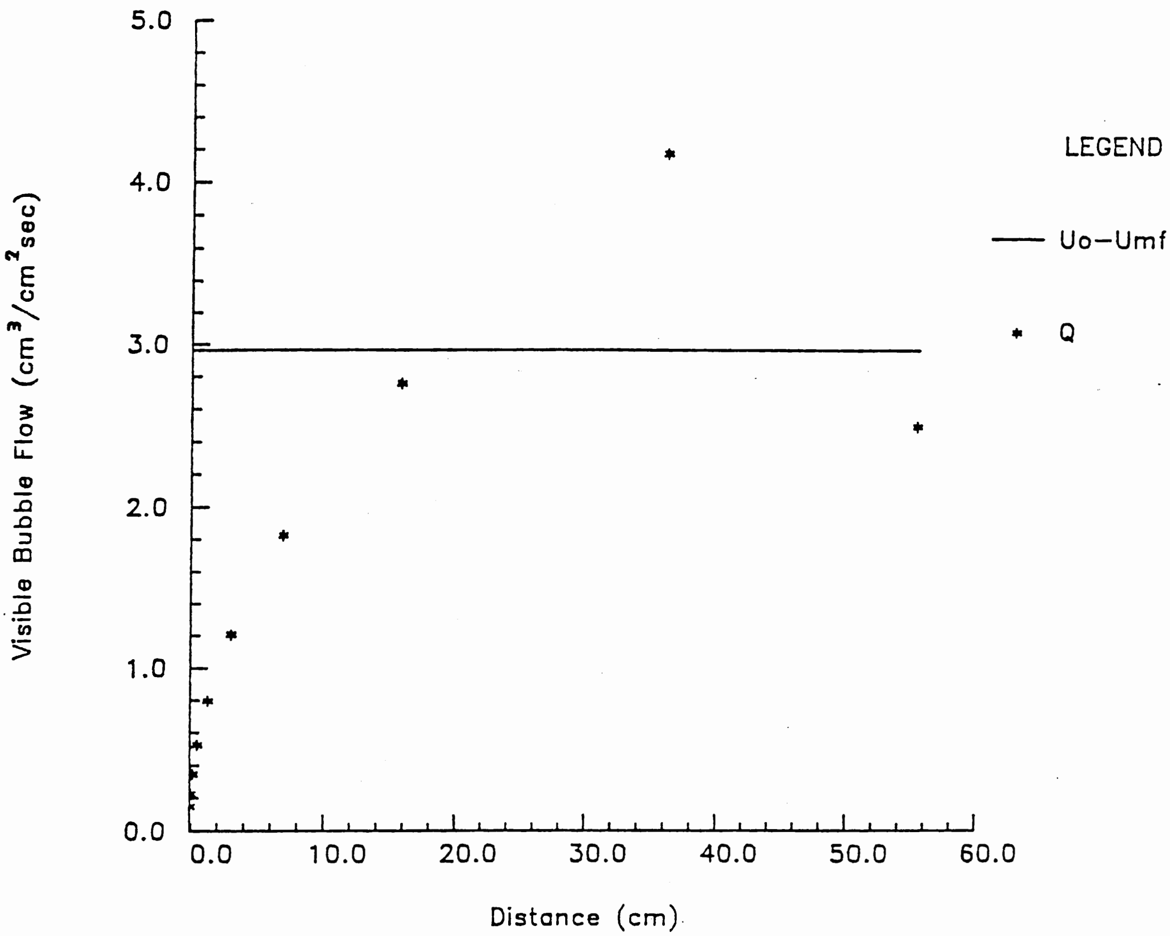

Figure 7. Comparison of the Visible Bubble Flow by Two Phase Theory and the Visible Bubble Flow used in the New Model (Massimilla (38): $U_o = 3.4$ cm/s and $k = 0.045\ s^{-1}$)

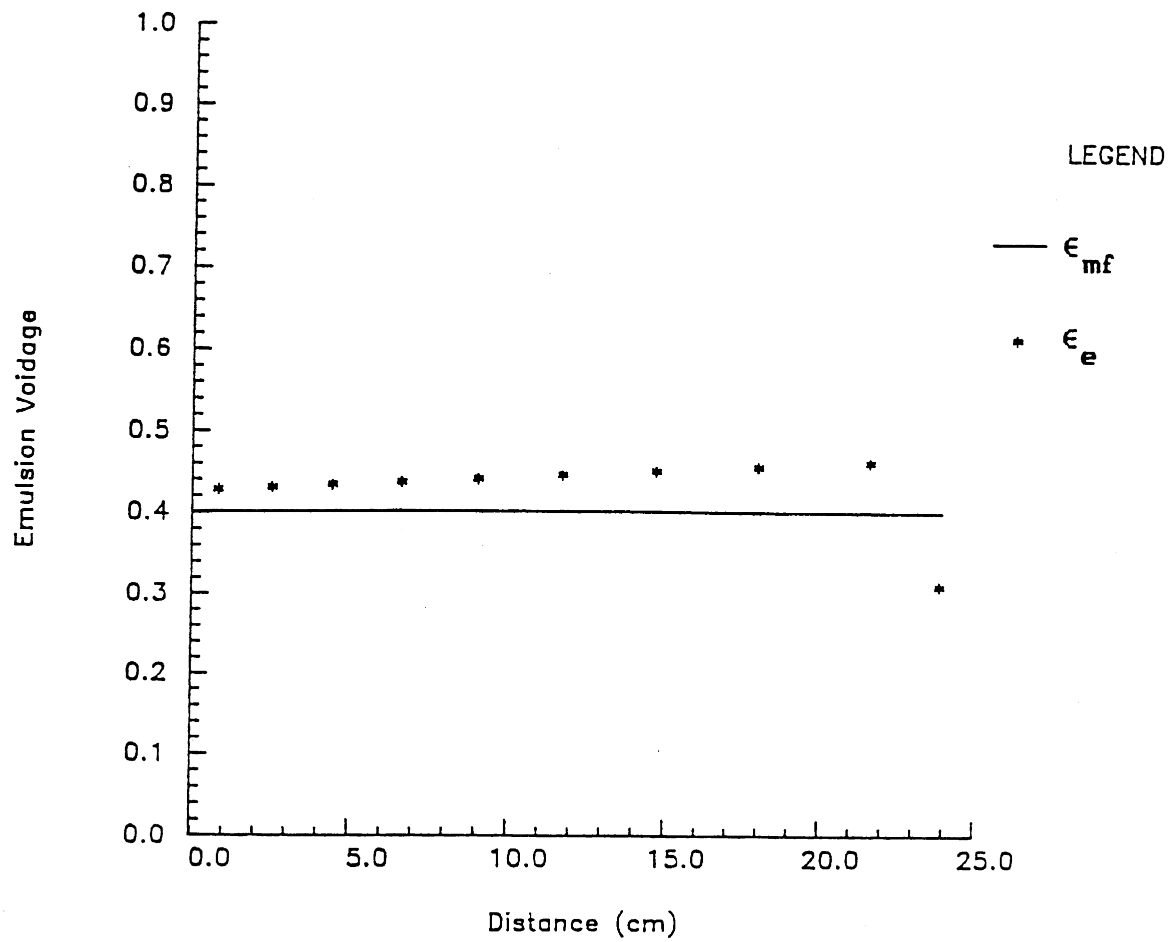

Figure 8. Comparison of Minimum Fluidizing Voidage and Calculated Emulsion Voidage (Fryer et al (36): Uo = 4.27 cm/s and k = 0.33 s^{-1})

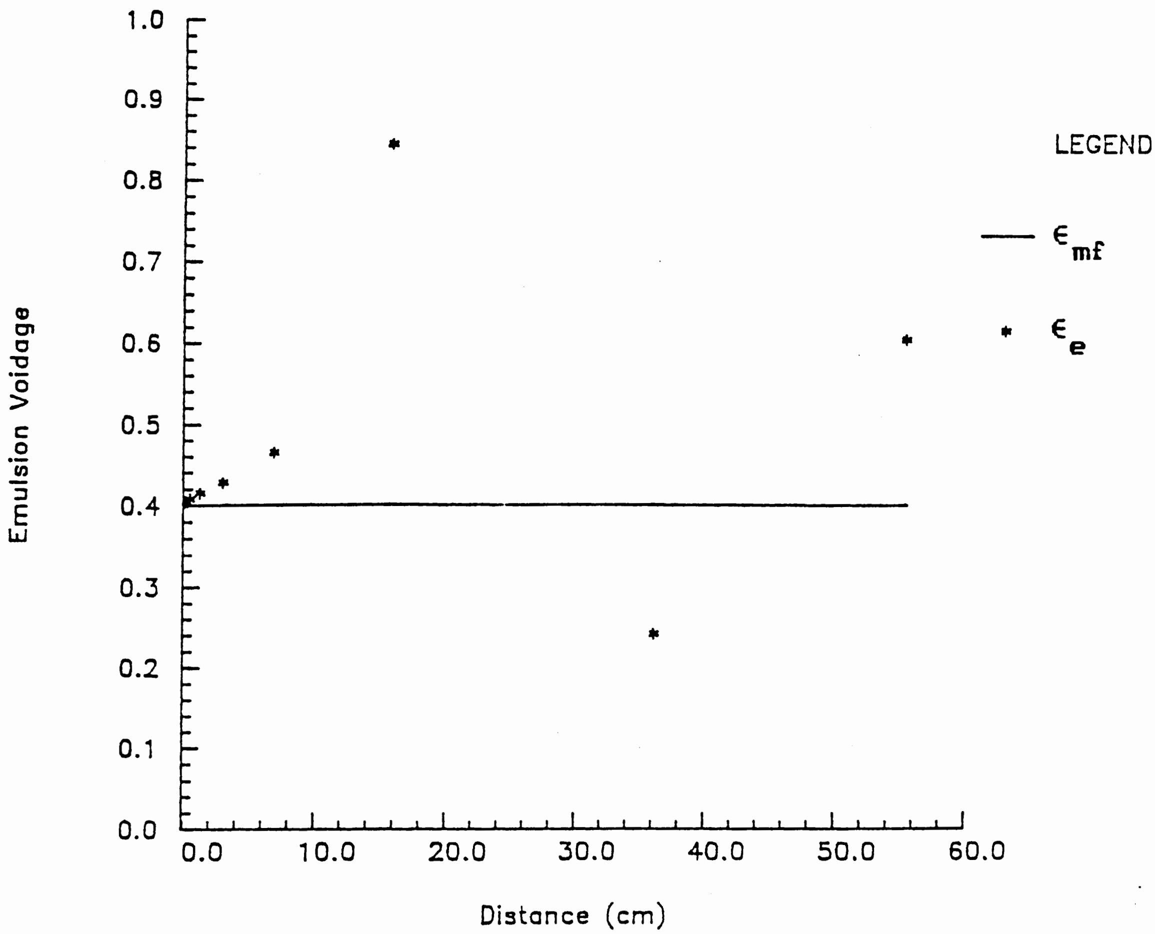

Figure 9. Comparison of Minimum Fluidizing Voidage and Calculated Emulsion Voidage (Massimilla et al (38): Uo = 3.4 cm/s and k = 0.045 s^{-1})

tioned previously.

Model Verification by Experimental Data

Comparisions of the present model prediction of the conversion in the fluidized bed reactor and the experimental data shown in Table 1 are shown in Figures 10-15. Also shown in Figures 10-15 is the conversions from the Kato-Wen model.

In Figures 10-13, the present model predictions are shown to be reasonable agreement with the experimental data, while in Figure 14 and Figure 15, the agreement is clearly not as good because of the minimum fluidizing velocity being too low, hence outside the valid range of the model. In addition, the factor, B, defined by Eq (7) in Appendix A is too large, hence the emulsion voidage is not equal to the bed voidage at minimum fluidizing conditions.

The foundation of the proposed model lies on the assumption that is that the emulsion voidage is equal to that of the bed at minimum fluidizing conditions. Hence further investigation on the factors which have influence on the emulsion voidage is needed. They include bubble voidage, solid particle mixing pattern, and gas mixing in the emulsion phase.

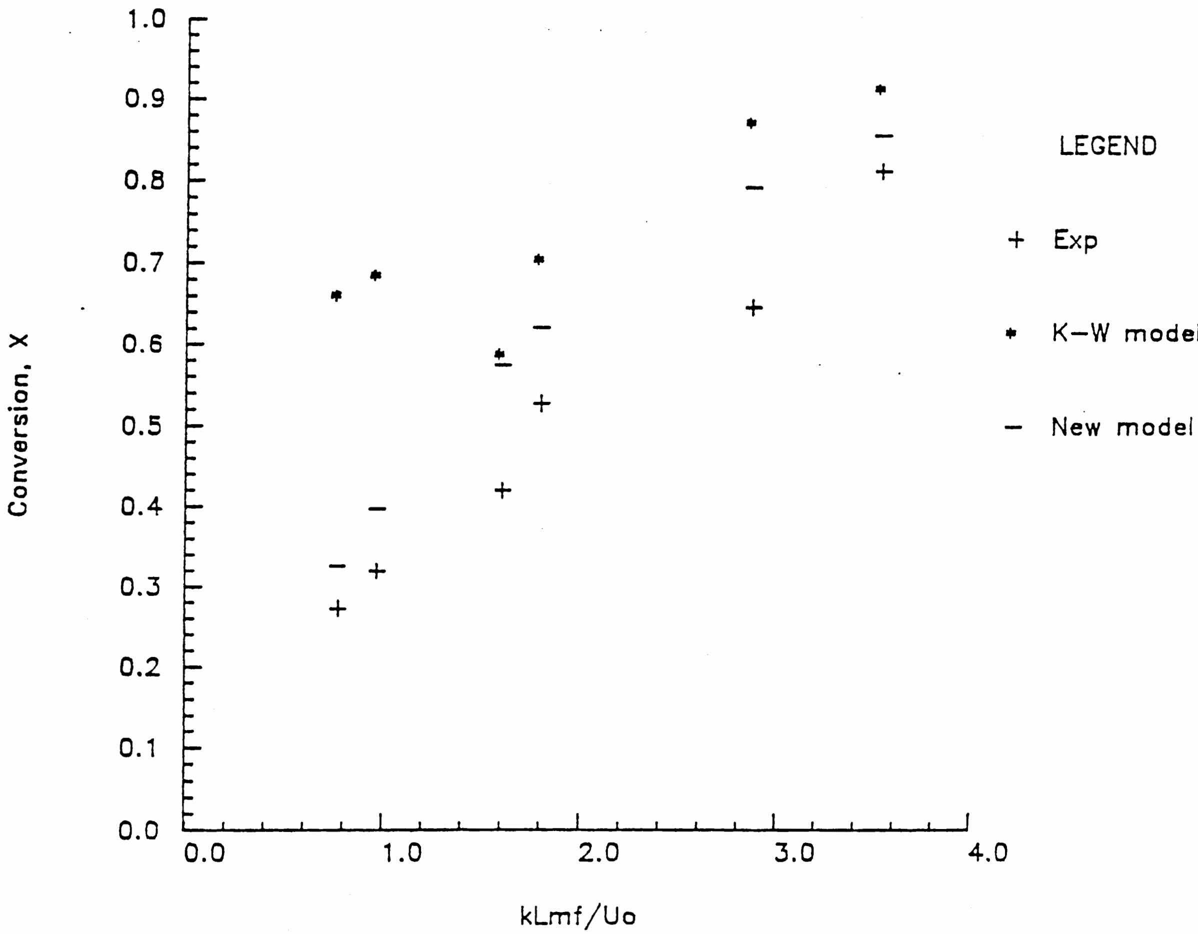

Figure 10. Comparison of Calculated Conversion and Experimental Data: Fryer et al (36)

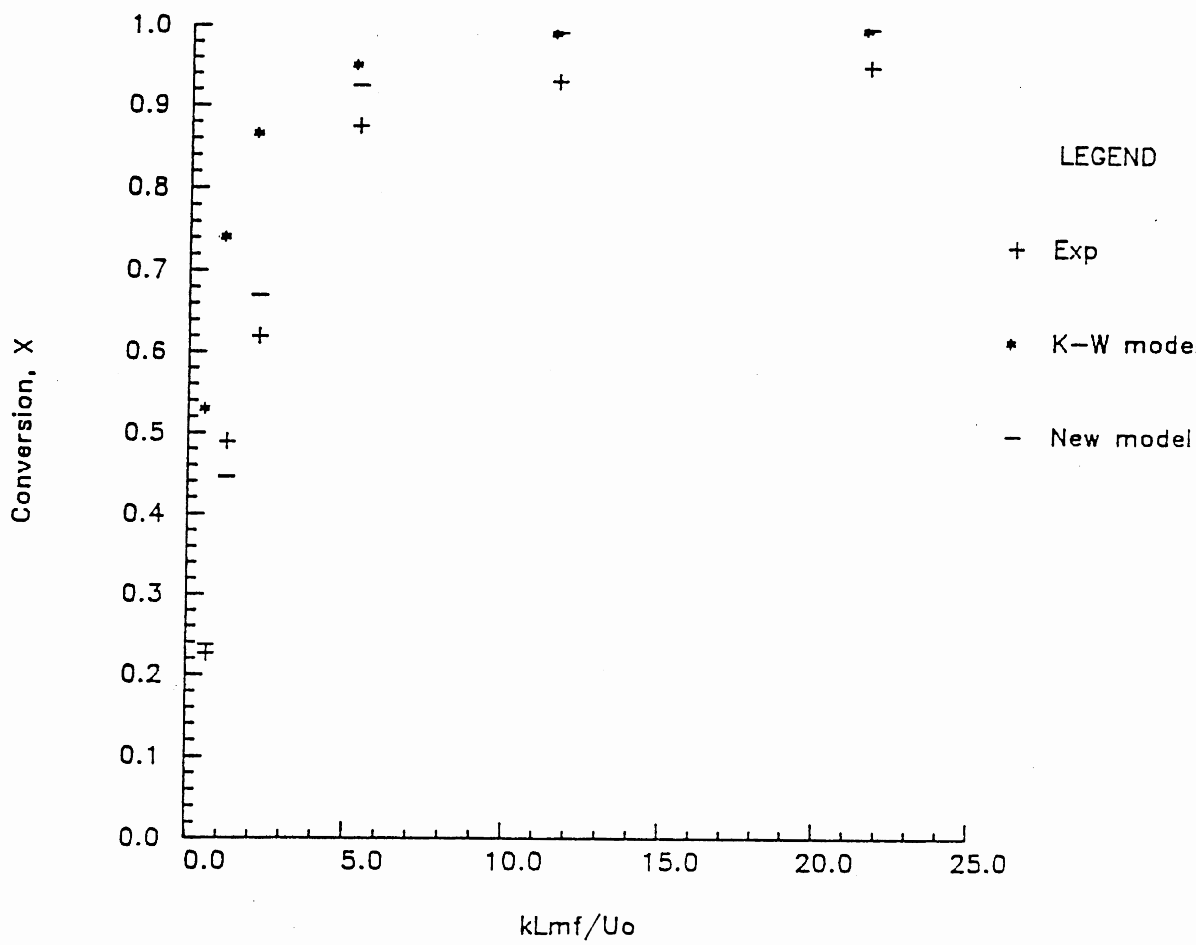

Figure 11. Comparison of Calculated Conversion and Experimental Data: Calderbank et al (37)

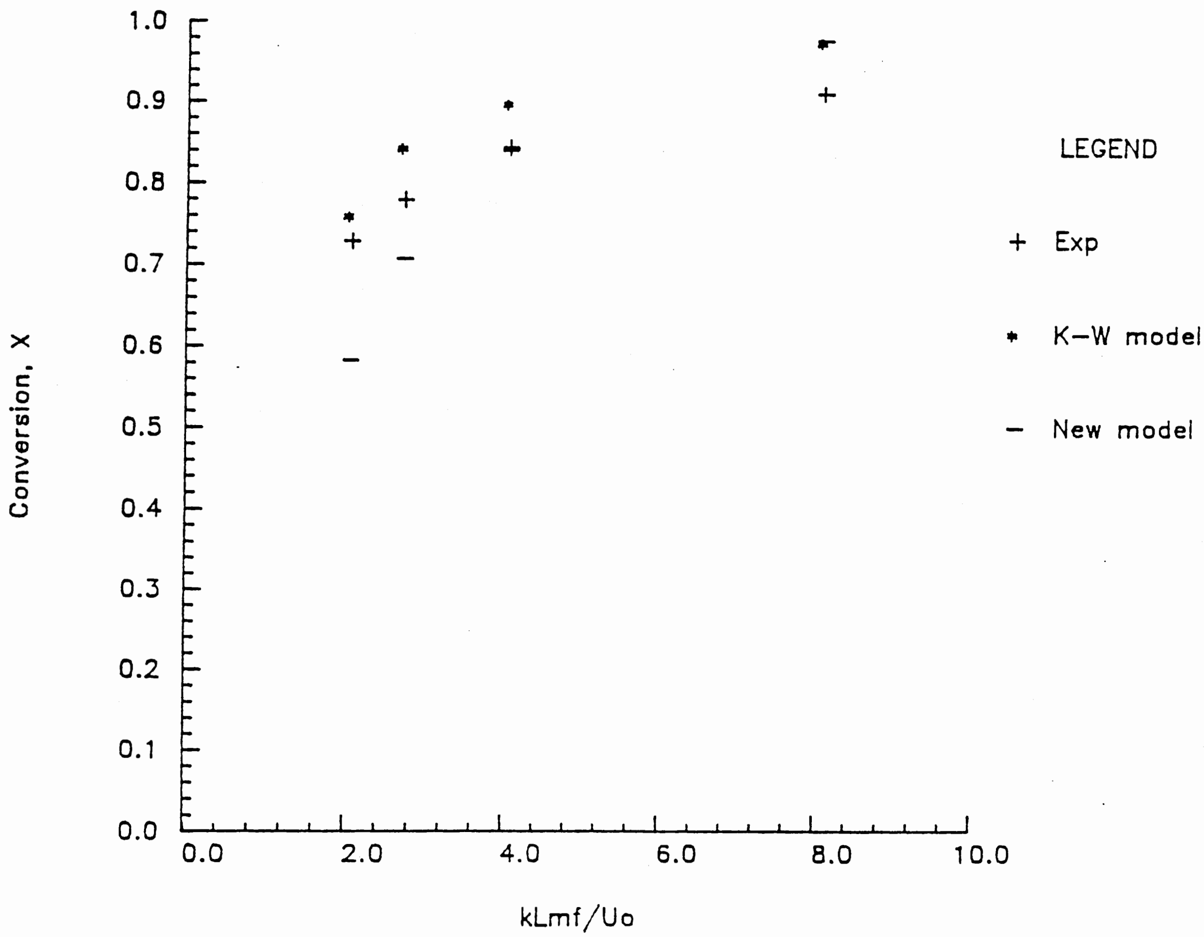

Figure 12. Comparison of Calculated Conversion and Experimental Data: Kobayashi et al (15)

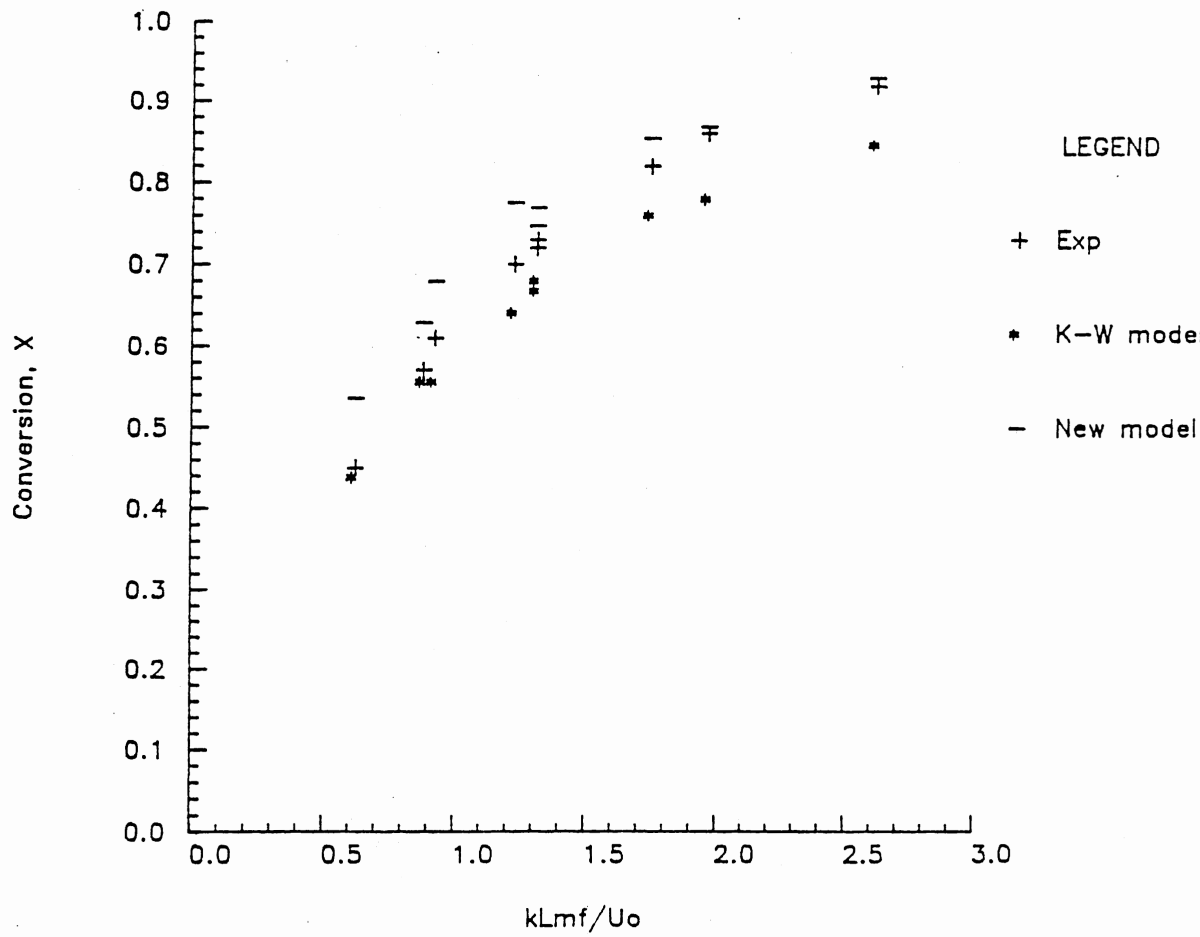

Figure 13. Comparison of Calculated Conversion and Experimental Data: Grace et al (12)

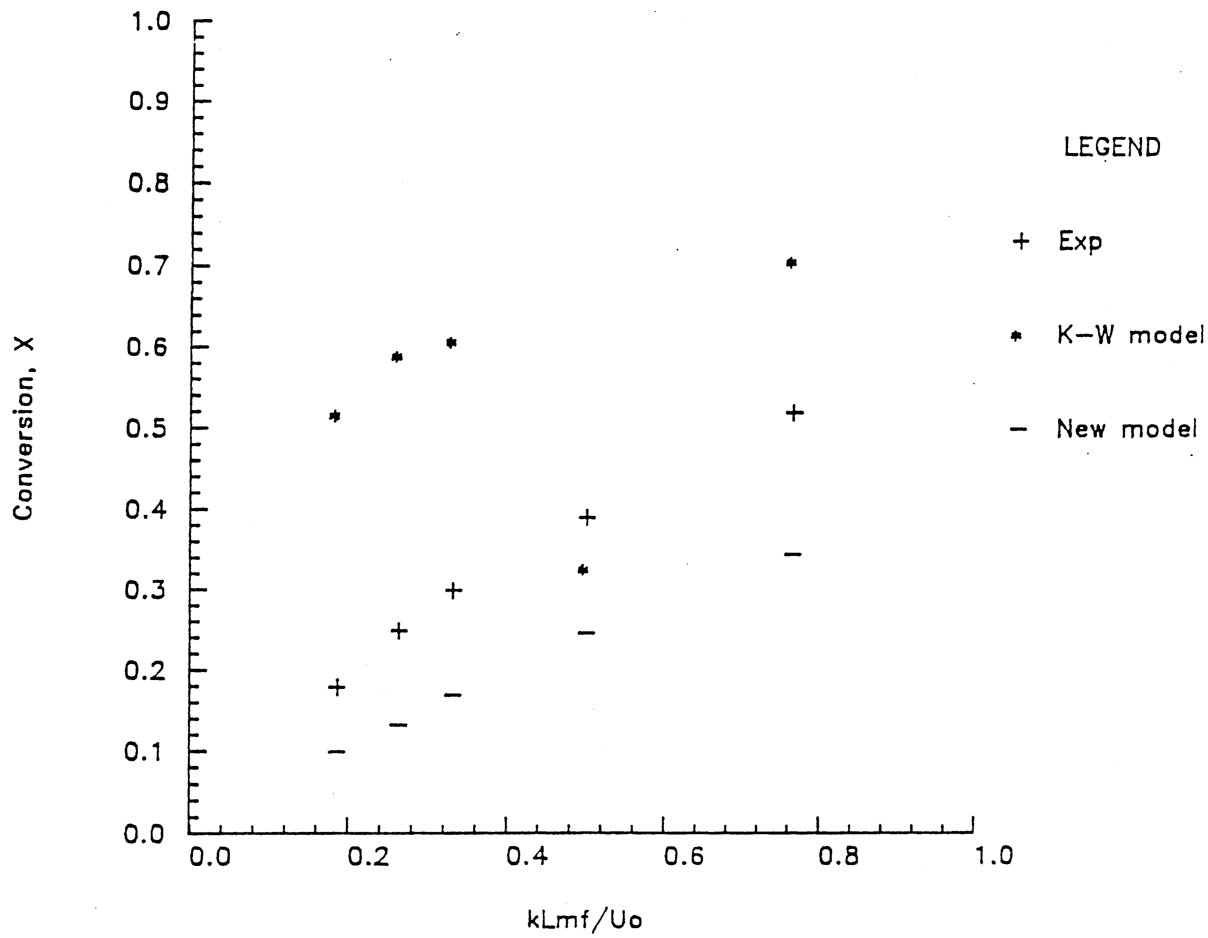

Figure 14. Comparison of Calculated Conversion and Experimental Data: Massimilla et al (38)

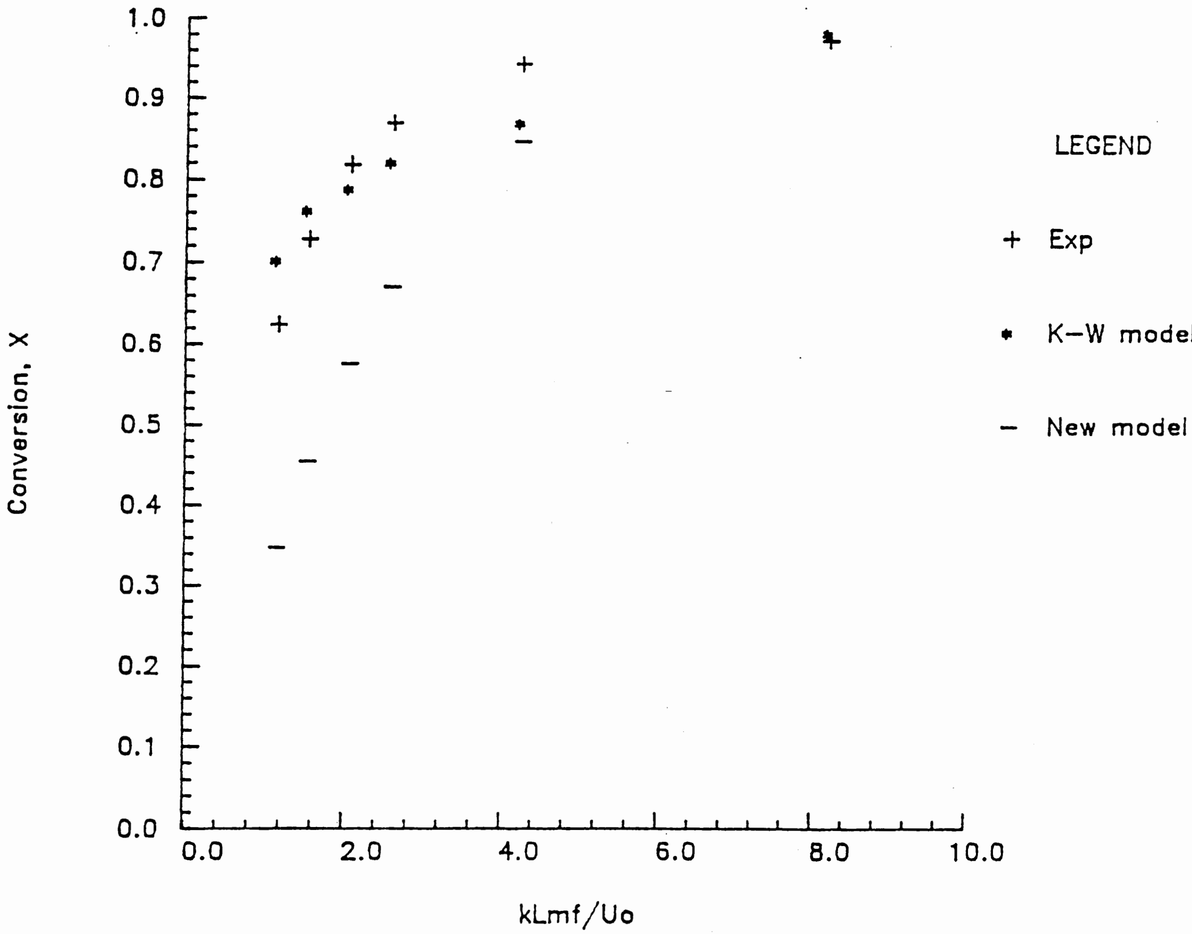

Figure 15. Comparison of Calculated Conversion and Experimental Data: Lewis et al (39)

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on bubble assemblage concepts, a mathematical model is developed for isothermal catalytic fluidized bed reactors. Model predictions are in reasonably good agreement with experimental results which were obtained under the operating condition, $U_{mf} > 0.5$ cm/s, but below the value of 0.5 cm/s the agreement is not as good.

The new model fit the observed conversion in fluidized beds better than the bubble assemblage model, especially under the operating conditions, $kL_{mf}/U_o < 10$, where a large amount of gas flows through the emulsion phase. In addition, the present method for evaluating the gas volumetric flux through the bubble phase verifies the overestimation of the visible bubble flow predicted by the two phase theory.

The present study also suggests a method for the prediction of emulsion void fraction in a fluidized bed reactor.

Recommendations

Recommendations for further possible research for the improvement of the model developed in this study are as follows:

The correct prediction of emulsion gas voidage is a key parameter to the success of the new model. Hence, further investigation on the factors which influence emulsion voidage is needed. They include bubble voidage, solid particle mixing pattern, gas mixing in the emulsion phase, and wake-bubble ratio.

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APPENDIX A

RELATIONSHIP BETWEEN THE VOIDAGE IN THE EMULSION PHASE AND THAT OF THE BED AT MINIMUM FLUIDIZING CONDITIONS

If Q_T is the total volumetric gas flow rate into the bed, Q_b the bubble flow rate and Q_e the emulsion flow rate, Q_T is given by

$$Q_T = Q_b + Q_e \tag{1}$$

Dividing through by the bed area gives the following relationship between the total flow and that through the two phases,

$$U_0 = U_b \delta + \epsilon_e U_e (1 - \delta) \tag{2}$$

Arrangement of Eq (2) gives,

$$\epsilon_e = \frac{U_0 - U_b \delta}{U_e (1 - \delta)} \tag{3}$$

When the emulsion voidage is equal to that of the bed at minimum fluidizing conditions, the upward gas velocity within emulsion phase, U_e, is equal to U_{mf}/ϵ_{mf} according to the two phase theory (5). However, if solids circulate in the bed, the gas velocity in the emulsion phase is given by (7),

$$U_e = \frac{U_{mf}}{\epsilon_{mf}} - U_s \qquad (4)$$

where the downward flowing solid velocity, U_s, is given by

$$U_s = \frac{U_b \ \delta \ f_w}{1 - \delta \ (1 + f_w)} \qquad (5)$$

The f_w is the ratio of volume of wake to volume of bubble (f_w = 0.20 to 0.4). Combining Eq (3), Eq (4) and the two phase assumption gives

$$\epsilon_e = \frac{\epsilon_{mf}}{1 - B \ \epsilon_{mf}} \qquad (6)$$

$$\text{where} \quad B = \frac{(1 - \delta) \ U_s}{U_o - U_b \ \delta} \qquad (7)$$

APPENDIX B-1

COPMPUTER PROGRAM FOR NEW MODEL

```
C
C THE FOLLOWING CALCULATION IS DONE BASED ON FRYER
C  AND POTTER'S DATA (NEW MODEL)
C
      IMPLICIT REAL*4(A-H,O-Z)
      REAL LMF,ND,LF,NR,K
      DIMENSION CONC(500),UU(6)
      DIMENSION AZNN(500),CB(500),CE(500),AUB(500)
      DIMENSION ANBUB(500),AVBUB(500),ADEL(500)
      DIMENSION COEFF(500),EXCO(500),ALPHA(500)
      DIMENSION SSIZE(500),HHT(500),EPS(500),CONV(500)
      DIMENSION VBF(500),VELS(500),DK(500),CBR(500)
      DIMENSION HALF(500),EMVC(500),CER(500),CONR(500)
      DATA DG/0.16/
      DATA EMF/0.4/
      DATA SSIZE,HHT,EPS,CONV/2000*0.0/
      DATA UU/2.17,2.67,4.27,4.8,8.0,10.13/
      DATA UMF/1.7/
      DATA LMF/23.1/
      DATA DP,RHOP,RHOG,DIA/0.0117,2.65,0.0012,22.9/
      DATA CONCO/0.00000446/
      DATA ND/241.0/
      DATA PHIK/0.7/
      DATA PHI/3.141592/
      DATA PSI/0.787/
      DATA G/980.67/
      DATA K/0.33/
      DATA AFW/0.3/
C
C DO LOOP
C
C       DO 47 JI=1,1
C         K=CONST(JI)
      DO 25 II= 1,6
        U0=UU(II)
      UFLUX=U0-UMF
      AMM=1.4*DP*RHOP*U0/UMF
C
C CALCULATE NUMBER OF REACTION UNIT, KLmf/Uo
C
      RN=K*LMF/U0
C
C PRINTING
C
      WRITE(6,32) U0,K,RN
   32 FORMAT(//1X,'U0=',F6.2,1X,'CM/S',2X,'K=',F6.3,
     1 1X,'1/SEC',3X,'KLmf/Uo=',F6.3)
C
C CALCULATE BED CROSS SECTIONAL AREA
C
```

```
      AREA=0.25*PHI*DIA**2
C
C CALCULATE MAXIMUM ATTAINABLE BUBBLE DIAMETER
C
      PROD=(AREA*UFLUX)**0.4
      DBM=0.652*PROD
C      PROD=(AREA*PHIK*UFLUX/PSI)**0.4
C      DBM=0.431*PROD
C
C CALCULATE INITIAL BUBBLE DIAMETER
C
C      DB0=0.00376*UFLUX**2
      IF(U0.LT.4.0) THEN
       DB0=1.5*UFLUX**0.26
      ELSE
       DB0=0.7*UFLUX**0.83
      ENDIF
C      PROD2=(AREA*UFLUX/ND)**0.4
C      DB0=0.347*PROD2
C
C  CALCULATE BED EXPANSION HEIGHT
C
      AAY=0.7585-0.0013*UFLUX+0.0005*UFLUX**2
      HET=0.5*LMF
      VALUE=-0.3*HET/DIA
      DDH=DBM-(DBM-DB0)*EXP(VALUE)
      UUB=PSI*SQRT(G*DDH)
      ALF=1.0-AAY*UFLUX/UUB
      LF=LMF/ALF
      CB0=CONC0
      CE0=CONC0
      DHNP=DB0
      HEIGHT=0.0
      HN=0.0
      I=1
      AKBE0=11.0/DB0
      UB0=PSI*SQRT(G*DB0)
      H0=DB0
C
C CALCULATE SIZE OF EACH COMPARTMENT
C
  200 DENOM=1.0+0.15*(DHNP-DBM)/DIA
      SIZE=DHNP/DENOM
      SSIZE(I)=SIZE
      AHHT=HEIGHT+0.5*SIZE
      HALF(I)=AHHT
      HEIGHT=HEIGHT+SIZE
      HHT(I)=HEIGHT
C
C CALCULATE BUBBLE VELOCITY
```

```
C
      UB=PSI*SQRT(G*SIZE)
      AUB(I)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
C
C CALCULATE AVERAGE VOIDAGE (BUBBLE + INTERSTITIAL
C  GAS IN THE EMULSION PHASE)
C
      FA1=1.0-EMF
      FA2=(AHHT-LMF)/(LF-LMF)
      IF(AHHT .LT. LMF) THEN
       EPSIL=1.0-ALF*FA1
       EPS(I)=EPSIL
      ELSE
       EPSIL=1.0-ALF*FA1*EXP(-FA2)
       EPS(I)=EPSIL
      ENDIF
C
C CALCULATE THE NUMBER OF REACTION UNIT
C
      NR=K*(1.0-EPSIL)*SIZE/U0
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      FA4=(EPSIL-EMF)/(1.0-EMF)
      ANB=6.0*AREA*FA4/(PHI*SIZE**2)
      ANBUB(I)=ANB
      VBUB=ANB*PHI*SIZE**3/6.0
      AVBUB(I)=VBUB
      DELTA=VBUB/(AREA*SIZE)
      ADEL(I)=DELTA
C
C CALCULATE VISIBLE BUBBLE FLOW
C
      VBF(I)=DELTA*UB
C
C CALCULATE PARTICLE VELOCITY IN EMULSION PHASE
C
      DA1=1.0-DELTA*(1.0+AFW)
      VELS(I)=UB*DELTA*AFW/DA1
C
C CALCULATE FACTOR, DK
C
      DA2=U0-UB*DELTA
      DK(I)=(1.0-DELTA)*VELS(I)/DA2
      EMVC(I)=EMF/(1.0-DK(I)*EMF)
C
```

```
C CALCULATE FACTORS
C
       IF(I .EQ. 1) THEN
         ZN=0.5*(H0+SSIZE(I))*AKBE0/UB0
        ELSE
         ZN=0.5*(SSIZE(I-1)+SSIZE(I))*EXCO(I-1)/AUB(I-1)
        ENDIF
       FA1=1.0/(1.0-DELTA)
       FA2=DELTA*FA1
       FA3=1.0-ZN
       FA4=1.0-DELTA
       FA5=FA4/(FA4+NR)
       FA6=DELTA/(FA4+NR)
C
C CALCULATE CONCENTRATIONS
C
       IF(I .EQ. 1) THEN
         CONC(I)=FA5*CONC0+FA6*NR*FA3*CB0+FA6*NR*ZN*CE0
         CE(I)=FA1*CONC(I)-FA2*FA3*CB0-FA2*ZN*CE0
         CB(I)=FA3*CB0+ZN*CE0
        ELSE
         CONC(I)=FA5*CONC(I-1)+FA6*NR*FA3*CB(I-1)+FA6*NR
     1     *ZN*CE(I-1)
         CE(I)=FA1*CONC(I)-FA2*FA3*CB(I-1)-FA2*ZN*CE(I-1)
         CB(I)=FA3*CB(I-1)+ZN*CE(I-1)
       ENDIF
       CONV(I)=1.0-CONC(I)/CONC0
C
C CHECK THE CONTINUATION
C
       IF(HEIGHT .GE. LF .OR. I .GT. 500) GO TO 1000
C        VALUE=1.0-EXP(-0.3*HEIGHT/DIA)
C        DHNP=DBM*VALUE
C       DHNP=DBM-(DBM-DB0)*(1.0-0.3*HEIGHT/DIA)
       VALUE=-0.3*HEIGHT/DIA
       DHNP=DBM-(DBM-DB0)*EXP(VALUE)
       HN=HEIGHT
       I=I+1
       GO TO 200
 1000  CONTINUE
       N=I
       SIZE=LF-HN
       SSIZE(N)=SIZE
       HHT(N)=LF
       AHHT=HN+0.5*SIZE
       HALF(N)=AHHT
C
C CALCULATE THE SIZE OF FINAL COMPARTMENT
C
       UB=PSI*SQRT(G*SIZE)
       AUB(N)=UB
```

```
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
C
C CALCULATE AVERAGE VOIDAGE (BUBBLE + INTERSTITIAL
C   GAS IN THE EMULSION PHASE)
C
      FA1=1.0-EMF
      FA2=(AHHT-LMF)/(LF-LMF)
      IF(AHHT .LT. LMF) THEN
       EPSIL=1.0-ALF*FA1
      ELSE
       EPSIL=1.0-ALF*FA1*EXP(-FA2)
       EPS(I)=EPSIL
      ENDIF
C
C CALCULATE THE NUMBER OF REACTION UNIT
C
      NR=K*(1.0-EPSIL)*SIZE/U0
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      FA4=(EPSIL-EMF)/(1.0-EMF)
      ANB=6.0*AREA*FA4/(PHI*SIZE**2)
      ANBUB(I)=ANB
      VBUB=ANB*PHI*SIZE**3/6.0
      AVBUB(I)=VBUB
      DELTA=VBUB/(AREA*SIZE)
      ADEL(I)=DELTA
C
C CALCULATE VISIBLE BUBBLE FLOW
C
      VBF(I)=DELTA*UB
C
C CALCULATE PARTICLE VELOCITY IN EMULSION PHASE
C
      DA1=1.0-DELTA*(1.0+AFW)
      VELS(I)=UB*DELTA*AFW/DA1
C
C CALCULATE FACTOR, DK
C
      DA2=U0-UB*DELTA
      DK(I)=(1.0-DELTA)*VELS(I)/DA2
      EMVC(I)=EMF/(1.0-DK(I)*EMF)
C
C CALCULATE FACTORS
C
      IF(I .EQ. 1) THEN
        ZN=0.5*(H0+SSIZE(I))*AKBE0/UB0
```

```
        ELSE
         ZN=0.5*(SSIZE(I-1)+SSIZE(I))*EXCO(I-1)/AUB(I-1)
        ENDIF
       FA1=1.0/(1.0-DELTA)
       FA2=DELTA*FA1
       FA3=1.0-ZN
       FA4=1.0-DELTA
       FA5=FA4/(FA4+NR)
       FA6=DELTA/(FA4+NR)
C
C CALCULATE CONCENTRATIONS
C
       CONC(I)=FA5*CONC(I-1)+FA6*NR*FA3*CB(I-1)+FA6*NR
     1  *ZN*CE(I-1)
       CE(I)=FA1*CONC(I)-FA2*FA3*CB(I-1)-FA2*ZN*CE(I-1)
       CB(I)=FA3*CB(I-1)+ZN*CE(I-1)
       CONV(I)=1.0-CONC(I)/CONCO
C
C CALCULATE CONCENTRATION RATIO
C
       DO 87 NA=1,N
        CBR(NA)=CB(NA)/CONCO
        CER(NA)=CE(NA)/CONCO
        CONR(NA)=CONC(NA)/CONCO
   87 CONTINUE
C
C PRINTING
C
       WRITE(6,42)
   42 FORMAT(/3X,'I',5X,'Hn',5X,'SIZE',5X,'UB',3X,
     1 'EPSIL',3X,'DELTA',5X,'KBE')
       DO 37 J=1,N
       WRITE(6,20) J,HALF(J),SSIZE(J),AUB(J),EPS(J),
     1  ADEL(J),EXCO(J)
   20 FORMAT(1X,I3,2X,F6.2,2X,F6.2,2X,F6.2,1X,F6.3,
     1  2X,F6.3,1X,F8.2)
   37 CONTINUE
       WRITE(6,44)
   44 FORMAT(/3X,'I',4X,'Hn',4X,'U0-UMF',3X,'Q
     1 ',4X,'Us',7X,'B',5X,'EMF',2X,'CAL EMF')
       DO 39 JA=1,N
       WRITE(6,46)JA,HALF(JA),UFLUX,VBF(JA),VELS(JA),
     1  DK(JA),EMF,EMVC(JA)
   46 FORMAT(1X,I3,1X,F6.2,2X,F6.3,1X,F6.3,F6.2,1X,
     1  F8.3,1X,F6.3,1X,F6.3)
   39 CONTINUE
       WRITE(6,48)
   48 FORMAT(/3X,'I',5X,'HHT',6X,'Hn',5X,'CB/C0',4X,
     1  'CE/C0',4X,'C/C0',5X,'CONV')
       DO 41 JB=1,N
       WRITE(6,52)JB,HHT(JB),HALF(JB),CBR(JB).CER(JB),
```

```
      1  CONR(JB),CONV(JB)
     52 FORMAT(1X,I3,2X,F6.2,3X,F6.2,3X,F6.3,3X,F6.3,3X,
      1  F6.3,3X,F6.3)
     41 CONTINUE
     25 CONTINUE
C     47 CONTINUE
       STOP
       END
```

APPENDIX B-2

COMPUTER PROGRAM FOR KATO-WEN MODEL

```
C
C THE FOLLOWING CALCULATION IS DONE BASED ON FRYER'S
C  DATA (KATO-WEN MODEL)
C
      IMPLICIT REAL*4(A-H,O-Z)
      REAL LMF,ND,LF,NR,K
      DIMENSION CONC(500),GEX(500),UU(6)
      DIMENSION CB(500),CE(500),AUB(500)
      DIMENSION COEFF(500),EXCO(500),ALPHA(500)
      DIMENSION SSIZE(500),HHT(500),CONV(500)
      DIMENSION CBR(500),CER(500),CONR(500)
      DATA DG/0.16/
      DATA EMF/0.4/
      DATA SSIZE,HHT,CONV/1500*0.0/
      DATA UU/2.17,2.67,4.27,4.8,8.0,10.13/
      DATA UMF/1.7/
      DATA LMF/23.1/
      DATA DP,RHOP,RHOG,DIA/0.0117,2.65,0.0012,22.9/
      DATA CONCO/0.00000446/
      DATA ND/241.0/
      DATA PHI/3.141592/
      DATA PSI/1.038/
      DATA G/980.67/
      DATA K/0.33/
C
C DO LOOP
C
C      DO 47 JI=1,1
C        K=CONST(JI)
      DO 25 II= 1,6
        U0=UU(II)
      UFLUX=U0-UMF
      AMM=1.4*DP*RHOP*U0/UMF
C
C CALCULATE NUMBER OF REACTION UNIT, KLmf/Uo
C
      RN=K*LMF/U0
C
C PRINTING
C
      WRITE(6,32) U0,K,RN
   32 FORMAT(//1X,'U0=',F6.2,1X,'CM/S',2X,'K=',F6.3,
     1  1X,'1/SEC',3X,'KLmf/Uo=',F6.3)
C
C CALCULATE BED CROSS SECTIONAL AREA
C
      AREA=0.25*PHI*DIA**2
C
C CALCULATE INITIAL BUBBLE DIAMETER
C
C      DB0=0.00376*UFLUX**2
```

```
      IF(U0.LT.4.0) THEN
       DB0=1.5*UFLUX**0.26
      ELSE
       DB0=0.7*UFLUX**0.83
      ENDIF
C       AG=UFLUX/ND
C       DB0=((6.0*AG/PHI)**0.4)/(G**0.2)
C
C  CALCULATE BED EXPANSION HEIGHT
C
      DBH=AMM*LMF/2.0+DB0
      UUB=0.711*(G*DBH)**0.5
      LF=LMF*(1.0+UFLUX/UUB)
      FACT1=(LF-LMF)/LF
      FACT2=LMF/LF
      CB0=CONC0
      CE0=CONC0
      HEIGHT=0.0
      HN=0.0
      I=1
      PA1=2.0+AMM
      PA2=2.0-AMM
C
C CALCULATE SIZE OF EACH COMPARTMENT
C
  200 SIZE=2.0*DB0*(PA1**(I-1))/(PA2**I)
      SSIZE(I)=SIZE
      HEIGHT=HEIGHT+SIZE
      HHT(I)=HEIGHT
C
C CALCULATE BUBBLE VELOCITY
C
      UB=0.711*SQRT(G*SIZE)
      AUB(I)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
      OA1=UB-UMF/EMF
      OA2=UB+2.0*UMF/EMF
      OA3=3.0*UMF/EMF
      AEXC=AKBE*OA1/OA2
      GEX(I)=AEXC
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      ANB=6.0*AREA*FACT1/(PHI*SIZE**2)
      VCLD=ANB*PHI*SIZE**3*OA3/(6.0*OA1)
      VBUB=ANB*PHI*SIZE**3*OA2/(6.0*OA1)
      VEML=AREA*SIZE-VBUB
```

```
      FA1=AEXC*VBUB+K*VCLD+AREA*U0-((AEXC*VBUB)**2)
     1  /(AEXC*VBUB+K*VEML)
      FA2=AEXC*VBUB/(AEXC*VBUB+K*VEML)
C
C CALCULATE CONCENTRATIONS
C
      IF(I .EQ. 1) THEN
        CB(I)=AREA*U0*CB0/FA1
        CE(I)=FA2*CB(I)
        CONC(I)=FACT1*CB(I)+FACT2*CE(I)
       ELSE
        CB(I)=AREA*U0*CB(I-1)/FA1
        CE(I)=FA2*CB(I)
        CONC(I)=FACT1*CB(I)+FACT2*CE(I)
      ENDIF
      CONV(I)=1.0-CONC(I)/CONC0
C
C CHECK THE CONTINUATION
C
      IF(HEIGHT .GE. LF .OR. I .GT. 500) GO TO 1000
      HN=HEIGHT
      I=I+1
      GO TO 200
 1000 CONTINUE
      N=I
      SIZE=LF-HN
      SSIZE(N)=SIZE
      HHT(N)=LF
C
C CALCULATE THE SIZE OF FINAL COMPARTMENT
C
      UB=0.711*SQRT(G*SIZE)
      AUB(N)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
      OA1=UB-UMF/EMF
      OA2=UB+2.0*UMF/EMF
      AEXC=AKBE*OA1/OA2
      GEX(I)=AEXC
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      ANB=6.0*AREA*FACT1/(PHI*SIZE**2)
      VCLD=ANB*PHI*SIZE**3*OA3/(6.0*OA1)
      VBUB=ANB*PHI*SIZE**3*OA2/(6.0*OA1)
      VEML=AREA*SIZE-VBUB
      FA1=AEXC*VBUB+K*VCLD+AREA*U0-((AEXC*VBUB)**2)
     1  /(AEXC*VBUB+K*VEML)
```

```
      FA2=AEXC*VBUB/(AEXC*VBUB+K*VEML)
C
C CALCULATE CONCENTRATIONS
C
      IF(I .EQ. 1) THEN
        CB(I)=AREA*U0*CB0/FA1
        CE(I)=FA2*CB(I)
        CONC(I)=FACT1*CB(I)+FACT2*CE(I)
       ELSE
        CB(I)=AREA*U0*CB(I-1)/FA1
        CE(I)=FA2*CB(I)
        CONC(I)=FACT1*CB(I)+FACT2*CE(I)
      ENDIF
      CONV(I)=1.0-CONC(I)/CONC0
C
C CALCULATE CONCENTRATION RATIO
C
      DO 87 NA=1,N
        CBR(NA)=CB(NA)/CONC0
        CER(NA)=CE(NA)/CONC0
        CONR(NA)=CONC(NA)/CONC0
   87 CONTINUE
C
C PRINTING
C
      WRITE(6,42)
   42 FORMAT(/3X,'I',3X,'SIZE',2X,'HEIGHT',2X,'CB/CO',
     1  2X,'CE/CO',2X,'C/CO',3X,'CONVERSION')
      DO 37 J=1,I
      WRITE(6,20) J,SSIZE(J),HHT(J),CBR(J),CER(J),
     1  CONR(J),CONV(J)
   20 FORMAT(1X,I3,2X,F6.3,1X,F6.3,1X,F6.3,1X,F6.3,
     1  1X,F6.3,3X,F6.3)
   37 CONTINUE
   25 CONTINUE
C   47 CONTINUE
      STOP
      END
```

APPENDIX B-3

COMPUTER PROGRAM FOR NEW MODEL (GRACE)

```
C
C THE FOLLOWING CALCULATION IS DONE BASED ON GRACE'S
C   DATA (NEW MODEL)
C
      IMPLICIT REAL*4(A-H,O-Z)
      REAL LMF,ND,LF,NR,K
      DIMENSION CONC(500),UU(3),CONST(3)
      DIMENSION AZNN(500),CB(500),CE(500),AUB(500)
      DIMENSION ANBUB(500),AVBUB(500),ADEL(500)
      DIMENSION COEFF(500),EXCO(500),ALPHA(500)
      DIMENSION SSIZE(500),HHT(500),EPS(500),CONV(500)
      DIMENSION VBF(500),VELS(500),DK(500),CBR(500)
      DIMENSION HALF(500),EMVC(500),CER(500),CONR(500)
      DATA DG/0.16/
      DATA EMF/0.4/
      DATA SSIZE,HHT,EPS,CONV/2000*0.0/
      DATA UU/10.0,15.0,21.4/
      DATA UMF/5.3/
      DATA LMF/130.0/
      DATA DP,RHOP,RHOG,DIA/0.0215,2.4,0.0012,8.4/
      DATA CONCO/0.000004464/
      DATA ND/9.0/
      DATA PHIK/0.7/
      DATA PHI/3.141592/
      DATA PSI/0.64/
      DATA G/980.67/
      DATA CONST/0.1,0.15,0.2/
      DATA W,AREA/1.0,56.0/
      DATA AFW/0.3/
C
C DO LOOP
C
      DO 47 JI=1,3
        K=CONST(JI)
      DO 25 II= 1,3
        UO=UU(II)
      UFLUX=UO-UMF
C
C CALCULATE NUMBER OF REACTION UNIT, KLmf/Uo
C
      RN=K*LMF/UO
C
C PRINTING
C
      WRITE(6,32) UO,K,RN
   32 FORMAT(//1X,'UO=',F6.2,1X,'CM/S',2X,'K=',F6.3,
     1  1X,'1/SEC',3X,'KLmf/Uo=',F6.3)
C
C  CALCULATE BED EXPANSION HEIGHT
C
      AAY=0.7585-0.0013*UFLUX+0.0005*UFLUX**2
```

```
      HET=0.5*LMF
      DB=0.0053*U0*HET+2.1
      AB=PHI*DB**2/4.0
      UUB=13.0*AB**0.35
      ALF=1.0-AAY*UFLUX/UUB
      LF=LMF/ALF
      CB0=CONC0
      CE0=CONC0
      DB0=2.1
      EPST=0.0053*UFLUX**0.4
      HEIGHT=0.0
      HN=0.0
      I=1
      AKBE0=11.0/DB0
      AB0=PHI*DB0**2/4.0
      UB0=13.0*AB0**0.35
      AM=0.0053*U0
      D0=2.1
      H0=DB0
      PA1=2.0+AM
      PA2=2.0-AM
C
C CALCULATE SIZE OF EACH COMPARTMENT
C
  200 SIZE=2.0*D0*(PA1**(I-1))/(PA2**I)
      AB=PHI*SIZE**2/4.0
      SSIZE(I)=SIZE
      AHHT=HEIGHT+0.5*SIZE
      HALF(I)=AHHT
      HEIGHT=HEIGHT+SIZE
      HHT(I)=HEIGHT
C
C CALCULATE BUBBLE VELOCITY
C
      UB=13.0*AB**0.35
      AUB(I)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
C
C  CALCULATE AVERAGE VOIDAGE (BUBBLE + INTERSTITIAL
C    GAS IN THE EMULSION PHASE)
C
      FREQ=1150*EPST*SIZE**(-1.45)
      GB=FREQ*AB*W
      EPSIL=GB/(UB*AREA)
      EPS(I)=EPSIL
C
C CALCULATE THE NUMBER OF REACTION UNIT
```

```
C
      NR=K*(1.0-EPSIL)*SIZE/U0
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      ANB=SIZE*AREA*EPSIL/(0.25*PHI*SIZE**2*W)
      ANBUB(I)=ANB
      VBUB=ANB*PHI*SIZE**2*W/4.0
      DELTA=VBUB/(AREA*SIZE)
      ADEL(I)=DELTA
C
C CALCULATE VISIBLE BUBBLE FLOW
C
      VBF(I)=DELTA*UB
C
C CALCULATE PARTICLE VELOCITY IN EMULSION PHASE
C
      DA1=1.0-DELTA*(1.0+AFW)
      VELS(I)=UB*DELTA*AFW/DA1
C
C CALCULATE FACTOR, DK
C
      DA2=U0-UB*DELTA
      DK(I)=(1.0-DELTA)*VELS(I)/DA2
      EMVC(I)=EMF/(1.0-DK(I)*EMF)
C
C CALCULATE FACTORS
C
      IF(I .EQ. 1) THEN
        ZN=0.5*(H0+SSIZE(I))*AKBE0/UB0
       ELSE
        ZN=0.5*(SSIZE(I-1)+SSIZE(I))*EXCO(I-1)/AUB(I-1)
       ENDIF
      FA1=1.0/(1.0-DELTA)
      FA2=DELTA*FA1
      FA3=1.0-ZN
      FA4=1.0-DELTA
      FA5=FA4/(FA4+NR)
      FA6=DELTA/(FA4+NR)
C
C CALCULATE CONCENTRATIONS
C
      IF(I .EQ. 1) THEN
        CONC(I)=FA5*CONC0+FA6*NR*FA3*CB0+FA6*NR*ZN*CE0
        CE(I)=FA1*CONC(I)-FA2*FA3*CB0-FA2*ZN*CE0
        CB(I)=FA3*CB0+ZN*CE0
       ELSE
        CONC(I)=FA5*CONC(I-1)+FA6*NR*FA3*CB(I-1)+FA6*NR
     1    *ZN*CE(I-1)
        CE(I)=FA1*CONC(I)-FA2*FA3*CB(I-1)-FA2*ZN*CE(I-1)
        CB(I)=FA3*CB(I-1)+ZN*CE(I-1)
```

```
      ENDIF
      CONV(I)=1.0-CONC(I)/CONCO
C
C CHECK THE CONTINUATION
C
      IF(HEIGHT .GE. LF .OR. I .GT. 500) GO TO 1000
      HN=HEIGHT
      I=I+1
      GO TO 200
 1000 CONTINUE
      N=I
      SIZE=LF-HN
      SSIZE(N)=SIZE
      HHT(N)=LF
      AHHT=HN+0.5*SIZE
      HALF(N)=AHHT
C
C CALCULATE THE SIZE OF FINAL COMPARTMENT
C
      AB=PHI*SIZE**2/4.0
      UB=13.0*AB**0.35
      AUB(N)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
C
C  CALCULATE AVERAGE VOIDAGE (BUBBLE + INTERSTITIAL
C    GAS IN THE EMULSION PHASE)
C
      FREQ=1150*EPST*SIZE**(-1.45)
      GB=FREQ*AB*W
      EPSIL=GB/(UB*AREA)
      EPS(I)=EPSIL
C
C CALCULATE THE NUMBER OF REACTION UNIT
C
      NR=K*(1.0-EPSIL)*SIZE/U0
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      ANB=SIZE*AREA*EPSIL/(0.25*PHI*SIZE**2*W)
      ANBUB(I)=ANB
      VBUB=ANB*PHI*SIZE**2*W/4.0
      DELTA=VBUB/(AREA*SIZE)
      ADEL(I)=DELTA
C
C CALCULATE VISIBLE BUBBLE FLOW
C
      VBF(I)=DELTA*UB
```

```
C
C CALCULATE PARTICLE VELOCITY IN EMULSION PHASE
C
      DA1=1.0-DELTA*(1.0+AFW)
      VELS(I)=UB*DELTA*AFW/DA1
C
C CALCULATE FACTOR, DK
C
      DA2=U0-UB*DELTA
      DK(I)=(1.0-DELTA)*VELS(I)/DA2
      EMVC(I)=EMF/(1.0-DK(I)*EMF)
C
C CALCULATE FACTORS
C
      IF(I .EQ. 1) THEN
        ZN=0.5*(H0+SSIZE(I))*AKBE0/UB0
       ELSE
        ZN=0.5*(SSIZE(I-1)+SSIZE(I))*EXCO(I-1)/AUB(I-1)
       ENDIF
      FA1=1.0/(1.0-DELTA)
      FA2=DELTA*FA1
      FA3=1.0-ZN
      FA4=1.0-DELTA
      FA5=FA4/(FA4+NR)
      FA6=DELTA/(FA4+NR)
C
C CALCULATE CONCENTRATIONS
C
      CONC(I)=FA5*CONC(I-1)+FA6*NR*FA3*CB(I-1)+FA6*NR
     1  *ZN*CE(I-1)
      CE(I)=FA1*CONC(I)-FA2*FA3*CB(I-1)-FA2*ZN*CE(I-1)
      CB(I)=FA3*CB(I-1)+ZN*CE(I-1)
      CONV(I)=1.0-CONC(I)/CONC0
C
C CALCULATE CONCENTRATION RATIO
C
      DO 87 NA=1,N
       CBR(NA)=CB(NA)/CONC0
       CER(NA)=CE(NA)/CONC0
       CONR(NA)=CONC(NA)/CONC0
   87 CONTINUE
C
C PRINTING
C
      WRITE(6,42)
   42 FORMAT(/3X,'I',5X,'Hn',5X,'SIZE',5X,'UB',3X,
     1 'EPSIL',3X,'DELTA',5X,'KBE')
      DO 37 J=1,N
      WRITE(6,20) J,HALF(J),SSIZE(J),AUB(J),EPS(J),
     1  ADEL(J),EXCO(J)
   20 FORMAT(1X,I3,2X,F6.2,2X,F6.2,2X,F6.2,1X,F6.3,
```

```
     1  2X,F6.3,1X,F8.2)
  37 CONTINUE
     WRITE(6,44)
  44 FORMAT(/3X,'I',4X,'Hn',4X,'UO-UMF',3X,'Q
    1 ',4X,'Us',7X,'B',5X,'EMF',2X,'CAL EMF')
     DO 39 JA=1,N
      WRITE(6,46)JA,HALF(JA),UFLUX,VBF(JA),VELS(JA),
    1    DK(JA),EMF,EMVC(JA)
  46 FORMAT(1X,I3,1X,F6.2,2X,F6.3,1X,F6.3,F6.2,1X,F8.3,
    1  1X,F6.3,1X,F6.3)
  39 CONTINUE
     WRITE(6,48)
  48 FORMAT(/3X,'I',5X,'HHT',6X,'Hn',5X,'CB/CO',4X,'CE/CO',
    1 4X,'C/CO',5X,'CONV')
     DO 41 JB=1,N
     WRITE(6,52)JB,HHT(JB),HALF(JB),CBR(JB),CER(JB),
    1  CONR(JB),CONV(JB)
  52 FORMAT(1X,I3,2X,F6.2,3X,F6.2,3X,F6.3,3X,F6.3,3X,F6.3,
    1  3X,F6.3)
  41 CONTINUE
  25 CONTINUE
  47 CONTINUE
     STOP
     END
```

APPENDIX B-4

COMPUTER PROGRAM FOR KATO-WEN MODEL (GRACE)

```
C
C THE FOLLOWING CALCULATION IS DONE BASED ON GRACE'S
C  DATA (KATO-WEN MODEL)
C
      IMPLICIT REAL*4(A-H,O-Z)
      REAL LMF,ND,LF,NR,K
      DIMENSION CONC(500),GEX(500),UU(3),AK(3)
      DIMENSION CB(500),CE(500),AUB(500)
      DIMENSION COEFF(500),EXCO(500),ALPHA(500)
      DIMENSION SSIZE(500),HHT(500),CONV(500)
      DIMENSION CBR(500),CER(500),CONR(500)
      DATA DG/0.4/
      DATA EMF/0.4/
      DATA SSIZE,HHT,CONV/1500*0.0/
      DATA UU/10.0,15.0,21.4/
      DATA UMF/5.3/
      DATA LMF/130.0/
      DATA DP,RHOP,RHOG,DIA/0.0215,2.4,0.0012,8.4/
      DATA CONC0/0.000004464/
      DATA ND/9.0/
      DATA PHI/3.141592/
      DATA PSI/0.64/
      DATA G/980.67/
      DATA AK/0.1,0.15,0.2/
      DATA W,AREA/1.0,56.0/
C
C DO LOOP
C
      DO 47 JI=1,3
        K=AK(JI)
      DO 25 II= 1,3
        U0=UU(II)
      UFLUX=U0-UMF
      AMM=1.4*DP*RHOP*U0/UMF
C
C CALCULATE NUMBER OF REACTION UNIT, KLmf/Uo
C
      RN=K*LMF/U0
C
C PRINTING
C
      WRITE(6,32) U0,K,RN
   32 FORMAT(//1X,'U0=',F6.2,1X,'CM/S',2X,'K=',F6.3,
     1  1X,'1/SEC',3X,'KLmf/Uo=',F6.3)
C
C  CALCULATE BED EXPANSION HEIGHT
C
      DB0=2.1
      DBH=0.0053*U0*LMF/2.0+DB0
      ABB=PHI*DBH**2/4.0
      UUB=13.0*ABB**0.35
```

```
      LF=LMF*(1.0+UFLUX/UUB)
      FACT1=(LF-LMF)/LF
      FACT2=LMF/LF
      CB0=CONC0
      CE0=CONC0
      HEIGHT=0.0
      HN=0.0
      I=1
      AB0=PHI*DB0**2/4.0
      UB0=13.0*AB0**0.35
      AM=0.0053*U0
      FA1=2.0+AM
      FA2=2.0-AM
C
C CALCULATE SIZE OF EACH COMPARTMENT
C
  200 SIZE=2.0*DB0*(FA1**(I-1))/(FA2**I)
      AB=PHI*SIZE**2/4.0
      SSIZE(I)=SIZE
      HEIGHT=HEIGHT+SIZE
      HHT(I)=HEIGHT
C
C CALCULATE BUBBLE VELOCITY
C
      UB=13.0*AB**0.35
      AUB(I)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
      OA1=UB-UMF/EMF
      OA2=UB+2.0*UMF/EMF
      OA3=3.0*UMF/EMF
      AEXC=AKBE*OA1/OA2
      GEX(I)=AEXC
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      ANB=4.0*AREA*FACT1/(PHI*SIZE)
      VCLD=ANB*PHI*SIZE**2*OA3/(4.0*OA1)
      VBUB=ANB*PHI*SIZE**2*OA2/(4.0*OA1)
      VEML=AREA*SIZE-VBUB
      FA1=AEXC*VBUB+K*VCLD+AREA*U0-((AEXC*VBUB)**2)
     1  /(AEXC*VBUB+K*VEML)
      FA2=AEXC*VBUB/(AEXC*VBUB+K*VEML)
C
C CALCULATE CONCENTRATIONS
C
      IF(I .EQ. 1) THEN
        CB(I)=AREA*U0*CB0/FA1
```

```
         CE(I)=FA2*CB(I)
         CONC(I)=FACT1*CB(I)+FACT2*CE(I)
        ELSE
         CB(I)=AREA*U0*CB(I-1)/FA1
         CE(I)=FA2*CB(I)
         CONC(I)=FACT1*CB(I)+FACT2*CE(I)
       ENDIF
       CONV(I)=1.0-CONC(I)/CONC0
C
C CHECK THE CONTINUATION
C
      IF(HEIGHT .GE. LF .OR. I .GT. 500) GO TO 1000
      HN=HEIGHT
      I=I+1
      GO TO 200
 1000 CONTINUE
      N=I
      SIZE=LF-HN
      SSIZE(N)=SIZE
      HHT(N)=LF
C      AHHT=HN+0.5*SIZE
C
C CALCULATE THE SIZE OF FINAL COMPARTMENT
C
      AB=PHI*SIZE**2/4.0
      UB=13.0*AB**0.35
      AUB(N)=UB
C
C CALCULATE GAS EXCHANGE COEFFICIENT, Kbe
C
      AKBE=11.0/SIZE
      EXCO(I)=AKBE
      OA1=UB-UMF/EMF
      OA2=UB+2.0*UMF/EMF
      AEXC=AKBE*OA1/OA2
      GEX(I)=AEXC
C
C CALCULATE AVERAGE VOIDAGE IN THE N COMPARTMENT
C
      ANB=4.0*AREA*FACT1/(PHI*SIZE)
      VCLD=ANB*PHI*SIZE**2*OA3/(4.0*OA1)
      VBUB=ANB*PHI*SIZE**2*OA2/(4.0*OA1)
      VEML=AREA*SIZE-VBUB
      FA1=AEXC*VBUB+K*VCLD+AREA*U0-((AEXC*VBUB)**2)
     1  /(AEXC*VBUB+K*VEML)
      FA2=AEXC*VBUB/(AEXC*VBUB+K*VEML)
C
C CALCULATE CONCENTRATIONS
C
      IF(I .EQ. 1) THEN
        CB(I)=AREA*U0*CB0/FA1
```

```
        CE(I)=FA2*CB(I)
        CONC(I)=FACT1*CB(I)+FACT2*CE(I)
       ELSE
        CB(I)=AREA*U0*CB(I-1)/FA1
        CE(I)=FA2*CB(I)
        CONC(I)=FACT1*CB(I)+FACT2*CE(I)
      ENDIF
      CONV(I)=1.0-CONC(I)/CONCO
C
C CALCULATE CONCENTRATION RATIO
C
      DO 87 NA=1,N
        CBR(NA)=CB(NA)/CONCO
        CER(NA)=CE(NA)/CONCO
        CONR(NA)=CONC(NA)/CONCO
   87 CONTINUE
C
C PRINTING
C
      WRITE(6,42)
   42 FORMAT(/3X,'I',3X,'SIZE',3X,'HEIGHT',2X,'CB/CO',2X,
     1  'CE/CO',2X,'C/CO',3X,'CONVERSION')
      DO 37 J=1,I
      WRITE(6,20) J,SSIZE(J),HHT(J),CBR(J),CER(J),
     1  CONR(J),CONV(J)
   20 FORMAT(1X,I3,2X,F6.3,1X,F7.3,1X,F6.3,1X,F6.3,1X,
     1  F6.3,3X,F6.3)
   37 CONTINUE
   25 CONTINUE
   47 CONTINUE
      STOP
      END
```

APPENDIX C-1

COMPUTER OUTPUT BASED ON NEW MODEL (FRYER)

U0= 2.17 CM/S K= 0.330 1/SEC KLmf/Uo= 3.513

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.63	1.27	27.74	0.406	0.011	8.68
2	1.93	1.34	28.49	0.406	0.011	8.23
3	3.31	1.41	29.24	0.406	0.011	7.81
4	4.75	1.48	30.00	0.406	0.011	7.42
5	6.27	1.56	30.76	0.406	0.011	7.06
6	7.87	1.64	31.53	0.406	0.011	6.72
7	9.55	1.72	32.30	0.406	0.011	6.40
8	11.31	1.80	33.07	0.406	0.011	6.11
9	13.15	1.89	33.84	0.406	0.011	5.83
10	15.08	1.97	34.61	0.406	0.011	5.58
11	17.09	2.06	35.38	0.406	0.011	5.34
12	19.20	2.15	36.14	0.406	0.011	5.12
13	21.40	2.24	36.90	0.406	0.011	4.91
14	22.93	0.83	22.51	0.942	0.011	13.19

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.63	0.470	0.298	0.09	0.048	0.400	0.408
2	1.93	0.470	0.306	0.09	0.049	0.400	0.408
3	3.31	0.470	0.314	0.10	0.051	0.400	0.408
4	4.75	0.470	0.322	0.10	0.052	0.400	0.409
5	6.27	0.470	0.330	0.10	0.054	0.400	0.409
6	7.87	0.470	0.339	0.10	0.056	0.400	0.409
7	9.55	0.470	0.347	0.11	0.057	0.400	0.409
8	11.31	0.470	0.355	0.11	0.059	0.400	0.410
9	13.15	0.470	0.363	0.11	0.061	0.400	0.410
10	15.08	0.470	0.372	0.11	0.062	0.400	0.410
11	17.09	0.470	0.380	0.12	0.064	0.400	0.410
12	19.20	0.470	0.388	0.12	0.066	0.400	0.411
13	21.40	0.470	0.396	0.12	0.067	0.400	0.411
14	22.93	0.470	0.242	0.07	0.038	0.400	0.406

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	1.27	0.63	1.000	0.896	0.897	0.103
2	2.60	1.93	0.958	0.799	0.801	0.199
3	4.01	3.31	0.895	0.709	0.711	0.289
4	5.49	4.75	0.823	0.625	0.627	0.373
5	7.05	6.27	0.749	0.548	0.550	0.450
6	8.69	7.87	0.675	0.478	0.480	0.520
7	10.41	9.55	0.605	0.414	0.416	0.584
8	12.21	11.31	0.538	0.356	0.358	0.642
9	14.09	13.15	0.476	0.304	0.306	0.694
10	16.06	15.08	0.419	0.258	0.260	0.740
11	18.12	17.09	0.367	0.218	0.219	0.781
12	20.28	19.20	0.319	0.183	0.184	0.816
13	22.52	21.40	0.277	0.152	0.153	0.847
14	23.35	22.93	0.251	0.141	0.143	0.857

U0= 2.67 CM/S K= 0.330 1/SEC KLmf/Uo= 2.855

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.77	1.55	30.64	0.412	0.020	7.12
2	2.38	1.66	31.78	0.412	0.020	6.62
3	4.10	1.79	32.93	0.412	0.020	6.16
4	5.95	1.91	34.09	0.412	0.020	5.75
5	7.93	2.05	35.27	0.412	0.020	5.37
6.	10.05	2.19	36.46	0.412	0.020	5.03
7	12.31	2.33	37.65	0.412	0.020	4.71
8	14.72	2.48	38.84	0.412	0.020	4.43
9	17.28	2.64	40.03	0.412	0.020	4.17
10	20.00	2.80	41.21	0.412	0.020	3.93
11	22.48	2.17	36.32	0.412	0.020	5.07

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.77	0.970	0.605	0.19	0.088	0.400	0.415
2	2.38	0.970	0.627	0.19	0.093	0.400	0.415
3	4.10	0.970	0.650	0.20	0.097	0.400	0.416
4	5.95	0.970	0.673	0.21	0.102	0.400	0.417
5	7.93	0.970	0.696	0.21	0.106	0.400	0.418
6	10.05	0.970	0.719	0.22	0.111	0.400	0.419
7	12.31	0.970	0.743	0.23	0.116	0.400	0.420
8	14.72	0.970	0.766	0.24	0.121	0.400	0.420
9	17.28	0.970	0.790	0.24	0.127	0.400	0.421
10	20.00	0.970	0.813	0.25	0.132	0.400	0.422
11	22.48	0.970	0.717	0.22	0.111	0.400	0.419

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	1.55	0.77	1.000	0.897	0.899	0.101
2	3.21	2.38	0.962	0.799	0.803	0.197
3	4.99	4.10	0.903	0.707	0.711	0.289
4	6.91	5.95	0.835	0.620	0.625	0.375
5	8.96	7.93	0.764	0.540	0.544	0.456
6	11.14	10.05	0.691	0.466	0.470	0.530
7	13.48	12.31	0.621	0.398	0.403	0.597
8	15.96	14.72	0.554	0.337	0.342	0.658
9	18.60	17.28	0.491	0.283	0.287	0.713
10	21.39	20.00	0.432	0.236	0.239	0.761
11	23.56	22.48	0.385	0.204	0.207	0.793

U0= 4.27 CM/S K= 0.330 1/SEC KLmf/Uo= 1.785

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.81	1.63	31.45	0.428	0.047	6.75
2	2.54	1.83	33.33	0.428	0.047	6.01
3	4.48	2.05	35.27	0.428	0.047	5.37
4	6.65	2.29	37.27	0.428	0.047	4.81
5	9.07	2.55	39.32	0.428	0.047	4.32
6	11.75	2.82	41.41	0.428	0.047	3.90

7	14.72	3.12	43.53	0.428	0.047	3.53
8	18.00	3.43	45.66	0.428	0.047	3.20
9	21.60	3.76	47.80	0.428	0.047	2.92
10	23.86	0.77	21.61	0.706	0.510	14.30

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.81	2.570	1.486	0.48	0.163	0.400	0.428
2	2.54	2.570	1.575	0.50	0.178	0.400	0.431
3	4.48	2.570	1.667	0.53	0.195	0.400	0.434
4	6.65	2.570	1.761	0.56	0.214	0.400	0.437
5	9.07	2.570	1.858	0.59	0.235	0.400	0.441
6	11.75	2.570	1.957	0.63	0.258	0.400	0.446
7	14.72	2.570	2.057	0.66	0.283	0.400	0.451
8	18.00	2.570	2.158	0.69	0.311	0.400	0.457
9	21.60	2.570	2.259	0.72	0.342	0.400	0.463
10	23.86	2.570	11.016	9.80	-0.712	0.400	0.311

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	1.63	0.81	1.000	0.930	0.933	0.067
2	3.46	2.54	0.974	0.858	0.864	0.136
3	5.51	4.48	0.933	0.786	0.793	0.207
4	7.79	6.65	0.885	0.713	0.721	0.279
5	10.34	9.07	0.831	0.640	0.649	0.351
6	13.16	11.75	0.775	0.568	0.578	0.422
7	16.28	14.72	0.717	0.499	0.509	0.491
8	19.71	18.00	0.659	0.433	0.443	0.557
9	23.48	21.60	0.602	0.371	0.382	0.618
10	24.25	23.86	0.570	0.180	0.379	0.621

U0= 4.80 CM/S K= 0.330 1/SEC KLmf/Uo= 1.588

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.96	1.91	34.07	0.432	0.054	5.76
2	2.99	2.16	36.22	0.432	0.054	5.09
3	5.29	2.43	38.45	0.432	0.054	4.52
4	7.87	2.73	40.74	0.432	0.054	4.03
5	10.77	3.06	43.08	0.432	0.054	3.60
6	13.99	3.40	45.45	0.432	0.054	3.23
7	17.58	3.77	47.84	0.432	0.054	2.92
8	21.54	4.15	50.23	0.432	0.054	2.65
9	24.02	0.80	22.04	0.717	0.528	13.76

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.96	3.100	1.836	0.59	0.189	0.400	0.433
2	2.99	3.100	1.953	0.63	0.209	0.400	0.437
3	5.29	3.100	2.073	0.67	0.232	0.400	0.441
4	7.87	3.100	2.196	0.71	0.257	0.400	0.446
5	10.77	3.100	2.322	0.75	0.286	0.400	0.452
6	13.99	3.100	2.450	0.79	0.318	0.400	0.458
7	17.58	3.100	2.579	0.83	0.354	0.400	0.466

8	21.54	3.100	2.708	0.87	0.395	0.400	0.475
9	24.02	3.100	11.645	11.16	-0.769	0.400	0.306

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	1.91	0.96	1.000	0.927	0.931	0.069
2	4.07	2.99	0.975	0.852	0.859	0.141
3	6.51	5.29	0.935	0.777	0.785	0.215
4	9.24	7.87	0.887	0.700	0.711	0.289
5	12.29	10.77	0.834	0.625	0.636	0.364
6	15.69	13.99	0.777	0.551	0.563	0.437
7	19.46	17.58	0.720	0.479	0.492	0.508
8	23.62	21.54	0.662	0.412	0.426	0.574
9	24.42	24.02	0.629	0.191	0.423	0.577

U0= 8.00 CM/S K= 0.330 1/SEC KLmf/Uo= 0.953

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.75	3.50	46.09	0.453	0.089	3.14
2	5.53	4.06	49.67	0.453	0.089	2.71
3	9.90	4.68	53.31	0.453	0.089	2.35
4	14.91	5.34	56.97	0.453	0.089	2.06
5	20.61	6.05	60.62	0.453	0.089	1.82
6	24.49	1.73	32.37	0.705	0.509	6.37

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.75	6.300	4.101	1.39	0.325	0.400	0.460
2	5.53	6.300	4.418	1.50	0.381	0.400	0.472
3	9.90	6.300	4.742	1.61	0.450	0.400	0.488
4	14.91	6.300	5.068	1.72	0.534	0.400	0.509
5	20.61	6.300	5.393	1.83	0.639	0.400	0.537
6	24.49	6.300	16.469	14.59	-0.846	0.400	0.299

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	3.50	1.75	1.000	0.920	0.927	0.073
2	7.56	5.53	0.979	0.838	0.851	0.149
3	12.24	9.90	0.946	0.754	0.771	0.229
4	17.58	14.91	0.903	0.670	0.690	0.310
5	23.63	20.61	0.855	0.587	0.610	0.390
6	25.36	24.49	0.824	0.373	0.603	0.397

U0= 10.13 CM/S K= 0.330 1/SEC KLmf/Uo= 0.753

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	2.24	4.49	52.20	0.466	0.110	2.45
2	7.12	5.26	56.53	0.466	0.110	2.09
3	12.80	6.11	60.90	0.466	0.110	1.80
4	19.36	7.01	65.23	0.466	0.110	1.57
5	24.41	3.10	43.37	0.662	0.437	3.55

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	2.24	8.430	5.748	2.01	0.409	0.400	0.478
2	7.12	8.430	6.225	2.18	0.497	0.400	0.499
3	12.80	8.430	6.706	2.35	0.610	0.400	0.529
4	19.36	8.430	7.183	2.51	0.759	0.400	0.574
5	24.41	8.430	18.963	13.18	-0.840	0.400	0.299

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	4.49	2.24	1.000	0.919	0.928	0.072
2	9.75	7.12	0.982	0.836	0.852	0.148
3	15.85	12.80	0.951	0.750	0.772	0.228
4	22.86	19.36	0.912	0.664	0.691	0.309
5	25.96	24.41	0.892	0.512	0.674	0.326

APPENDIX C-2

COMPUTER OUTPUT BASED ON NEW MODEL (CALDERBANK)

U0= 5.75 CM/S K= 0.029 1/SEC KLmf/Uo= 0.500

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.01	0.02	4.14	0.462	0.022	677.74
2	0.03	0.02	4.37	0.462	0.022	607.43
3	0.04	0.02	4.62	0.462	0.022	544.41
4	0.07	0.02	4.88	0.462	0.022	487.94
5	0.09	0.03	5.16	0.462	0.022	437.37
6	0.12	0.03	5.45	0.462	0.022	392.02
7	0.15	0.03	5.75	0.462	0.022	351.37
8	0.18	0.03	6.07	0.462	0.022	314.94
9	0.22	0.04	6.42	0.462	0.022	282.31
10	0.26	0.04	6.78	0.462	0.022	253.07
11	0.30	0.05	7.16	0.462	0.022	226.85
12	0.35	0.05	7.56	0.462	0.022	203.37
13	0.41	0.06	7.98	0.462	0.022	182.32
14	0.48	0.07	8.43	0.462	0.022	163.46
15	0.55	0.08	8.91	0.462	0.022	146.55
16	0.63	0.08	9.40	0.462	0.022	131.40
17	0.71	0.09	9.93	0.462	0.022	117.82
18	0.81	0.10	10.49	0.462	0.022	105.66
19	0.92	0.12	11.08	0.462	0.022	94.75
20	1.05	0.13	11.69	0.462	0.022	84.98
21	1.18	0.14	12.35	0.462	0.022	76.23
22	1.34	0.16	13.04	0.462	0.022	68.38
23	1.51	0.18	13.76	0.462	0.022	61.35
24	1.70	0.20	14.53	0.462	0.022	55.05
25	1.91	0.22	15.34	0.462	0.022	49.40
26	2.14	0.25	16.19	0.462	0.022	44.34
27	2.40	0.28	17.09	0.462	0.022	39.80
28	2.70	0.31	18.03	0.462	0.022	35.74
29	3.02	0.34	19.03	0.462	0.022	32.09
30	3.38	0.38	20.08	0.462	0.022	28.83
31	3.79	0.42	21.18	0.462	0.022	25.90
32	4.24	0.47	22.34	0.462	0.022	23.28
33	4.73	0.53	23.56	0.462	0.022	20.93
34	5.29	0.58	24.85	0.462	0.022	18.83
35	5.91	0.65	26.19	0.462	0.022	16.94
36	6.59	0.72	27.61	0.462	0.022	15.25
37	7.35	0.80	29.09	0.462	0.022	13.74
38	8.20	0.89	30.64	0.462	0.022	12.38
39	9.13	0.99	32.27	0.462	0.022	11.16
40	10.17	1.09	33.97	0.462	0.022	10.07
41	11.32	1.21	35.75	0.462	0.022	9.09
42	12.60	1.34	37.61	0.462	0.022	8.22
43	14.01	1.48	39.54	0.462	0.022	7.43
44	15.56	1.63	41.56	0.462	0.022	6.73
45	17.28	1.80	43.65	0.462	0.022	6.10
46	19.18	1.99	45.83	0.462	0.022	5.53
47	21.27	2.19	48.08	0.462	0.022	5.03
48	23.56	2.40	50.41	0.462	0.022	4.57

49	26.09	2.64	52.81	0.462	0.022	4.17
50	28.85	2.89	55.28	0.462	0.022	3.80
51	31.88	3.16	57.82	0.462	0.022	3.48
52	35.19	3.45	60.42	0.462	0.022	3.18
53	38.80	3.76	63.07	0.462	0.022	2.92
54	42.73	4.09	65.77	0.462	0.022	2.69
55	47.00	4.44	68.51	0.462	0.022	2.48
56	51.62	4.81	71.28	0.462	0.022	2.29
57	56.62	5.19	74.07	0.462	0.022	2.12
58	62.01	5.59	76.87	0.462	0.022	1.97
59	67.81	6.01	79.67	0.462	0.022	1.83
60	74.03	6.43	82.46	0.462	0.022	1.71
61	80.69	6.87	85.22	0.462	0.022	1.60
62	87.78	7.32	87.95	0.462	0.022	1.50
63	95.33	7.77	90.63	0.462	0.022	1.42
64	100.25	2.06	46.60	0.685	0.428	5.35

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.01	2.020	0.091	0.03	0.005	0.450	0.451
2	0.03	2.020	0.096	0.03	0.005	0.450	0.451
3	0.04	2.020	0.101	0.03	0.005	0.450	0.451
4	0.07	2.020	0.107	0.03	0.006	0.450	0.451
5	0.09	2.020	0.113	0.03	0.006	0.450	0.451
6	0.12	2.020	0.119	0.04	0.006	0.450	0.451
7	0.15	2.020	0.126	0.04	0.007	0.450	0.451
8	0.18	2.020	0.133	0.04	0.007	0.450	0.451
9	0.22	2.020	0.140	0.04	0.008	0.450	0.452
10	0.26	2.020	0.148	0.05	0.008	0.450	0.452
11	0.30	2.020	0.156	0.05	0.008	0.450	0.452
12	0.35	2.020	0.165	0.05	0.009	0.450	0.452
13	0.41	2.020	0.175	0.05	0.009	0.450	0.452
14	0.48	2.020	0.184	0.06	0.010	0.450	0.452
15	0.55	2.020	0.195	0.06	0.011	0.450	0.452
16	0.63	2.020	0.206	0.06	0.011	0.450	0.452
17	0.71	2.020	0.217	0.07	0.012	0.450	0.452
18	0.81	2.020	0.229	0.07	0.013	0.450	0.453
19	0.92	2.020	0.242	0.07	0.013	0.450	0.453
20	1.05	2.020	0.256	0.08	0.014	0.450	0.453
21	1.18	2.020	0.270	0.08	0.015	0.450	0.453
22	1.34	2.020	0.285	0.09	0.016	0.450	0.453
23	1.51	2.020	0.301	0.09	0.017	0.450	0.453
24	1.70	2.020	0.318	0.10	0.018	0.450	0.454
25	1.91	2.020	0.335	0.10	0.019	0.450	0.454
26	2.14	2.020	0.354	0.11	0.020	0.450	0.454
27	2.40	2.020	0.374	0.12	0.021	0.450	0.454
28	2.70	2.020	0.394	0.12	0.022	0.450	0.455
29	3.02	2.020	0.416	0.13	0.024	0.450	0.455
30	3.38	2.020	0.439	0.14	0.025	0.450	0.455
31	3.79	2.020	0.463	0.14	0.026	0.450	0.455
32	4.24	2.020	0.488	0.15	0.028	0.450	0.456
33	4.73	2.020	0.515	0.16	0.030	0.450	0.456

34	5.29	2.020	0.543	0.17	0.032	0.450	0.456
35	5.91	2.020	0.573	0.18	0.033	0.450	0.457
36	6.59	2.020	0.603	0.19	0.035	0.450	0.457
37	7.35	2.020	0.636	0.20	0.038	0.450	0.458
38	8.20	2.020	0.670	0.21	0.040	0.450	0.458
39	9.13	2.020	0.705	0.22	0.042	0.450	0.459
40	10.17	2.020	0.743	0.23	0.045	0.450	0.459
41	11.32	2.020	0.781	0.24	0.048	0.450	0.460
42	12.60	2.020	0.822	0.25	0.050	0.450	0.460
43	14.01	2.020	0.864	0.27	0.053	0.450	0.461
44	15.56	2.020	0.908	0.28	0.057	0.450	0.462
45	17.28	2.020	0.954	0.29	0.060	0.450	0.463
46	19.18	2.020	1.002	0.31	0.064	0.450	0.463
47	21.27	2.020	1.051	0.32	0.068	0.450	0.464
48	23.56	2.020	1.102	0.34	0.072	0.450	0.465
49	26.09	2.020	1.154	0.36	0.076	0.450	0.466
50	28.85	2.020	1.208	0.37	0.080	0.450	0.467
51	31.88	2.020	1.264	0.39	0.085	0.450	0.468
52	35.19	2.020	1.321	0.41	0.090	0.450	0.469
53	38.80	2.020	1.379	0.43	0.095	0.450	0.470
54	42.73	2.020	1.438	0.44	0.101	0.450	0.471
55	47.00	2.020	1.498	0.46	0.106	0.450	0.473
56	51.62	2.020	1.558	0.48	0.112	0.450	0.474
57	56.62	2.020	1.619	0.50	0.118	0.450	0.475
58	62.01	2.020	1.680	0.52	0.125	0.450	0.477
59	67.81	2.020	1.741	0.54	0.131	0.450	0.478
60	74.03	2.020	1.802	0.56	0.138	0.450	0.480
61	80.69	2.020	1.863	0.58	0.145	0.450	0.481
62	87.78	2.020	1.922	0.59	0.152	0.450	0.483
63	95.33	2.020	1.981	0.61	0.159	0.450	0.485
64	100.25	2.020	19.926	13.46	-0.543	0.450	0.362

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.02	0.01	1.000	1.000	1.000	0.000
2	0.03	0.03	1.000	1.000	1.000	0.000
3	0.05	0.04	1.000	1.000	1.000	0.000
4	0.08	0.07	1.000	1.000	1.000	0.000
5	0.10	0.09	1.000	1.000	1.000	0.000
6	0.13	0.12	0.999	1.000	1.000	0.000
7	0.16	0.15	1.000	1.000	1.000	0.000
8	0.20	0.18	0.999	0.999	0.999	0.001
9	0.24	0.22	1.000	0.999	0.999	0.001
10	0.28	0.26	0.999	0.999	0.999	0.001
11	0.33	0.30	0.999	0.999	0.999	0.001
12	0.38	0.35	0.999	0.999	0.999	0.001
13	0.44	0.41	0.999	0.999	0.999	0.001
14	0.51	0.48	0.999	0.999	0.999	0.001
15	0.58	0.55	0.999	0.998	0.998	0.002
16	0.67	0.63	0.998	0.998	0.998	0.002
17	0.76	0.71	0.998	0.998	0.998	0.002
18	0.87	0.81	0.998	0.998	0.998	0.002

19	0.98	0.92	0.998	0.997	0.997	0.003
20	1.11	1.05	0.997	0.997	0.997	0.003
21	1.26	1.18	0.997	0.997	0.997	0.003
22	1.42	1.34	0.997	0.996	0.996	0.004
23	1.60	1.51	0.996	0.996	0.996	0.004
24	1.80	1.70	0.996	0.995	0.995	0.005
25	2.02	1.91	0.995	0.995	0.995	0.005
26	2.27	2.14	0.995	0.994	0.994	0.006
27	2.54	2.40	0.994	0.993	0.993	0.007
28	2.85	2.70	0.993	0.992	0.992	0.008
29	3.19	3.02	0.993	0.991	0.991	0.009
30	3.57	3.38	0.992	0.990	0.990	0.010
31	4.00	3.79	0.991	0.989	0.989	0.011
32	4.47	4.24	0.990	0.988	0.988	0.012
33	5.00	4.73	0.989	0.986	0.987	0.013
34	5.58	5.29	0.988	0.985	0.985	0.015
35	6.23	5.91	0.986	0.983	0.983	0.017
36	6.95	6.59	0.985	0.981	0.981	0.019
37	7.75	7.35	0.983	0.979	0.979	0.021
38	8.64	8.20	0.982	0.977	0.977	0.023
39	9.63	9.13	0.980	0.974	0.974	0.026
40	10.72	10.17	0.978	0.971	0.971	0.029
41	11.93	11.32	0.976	0.968	0.968	0.032
42	13.27	12.60	0.973	0.964	0.965	0.035
43	14.75	14.01	0.970	0.961	0.961	0.039
44	16.38	15.56	0.968	0.956	0.957	0.043
45	18.19	17.28	0.964	0.952	0.952	0.048
46	20.17	19.18	0.961	0.946	0.947	0.053
47	22.36	21.27	0.957	0.941	0.941	0.059
48	24.77	23.56	0.953	0.935	0.935	0.065
49	27.41	26.09	0.949	0.928	0.928	0.072
50	30.30	28.85	0.945	0.921	0.921	0.079
51	33.46	31.88	0.940	0.913	0.913	0.087
52	36.92	35.19	0.934	0.904	0.905	0.095
53	40.68	38.80	0.929	0.895	0.896	0.104
54	44.78	42.73	0.922	0.885	0.886	0.114
55	49.22	47.00	0.916	0.875	0.875	0.125
56	54.03	51.62	0.909	0.863	0.864	0.136
57	59.22	56.62	0.902	0.851	0.852	0.148
58	64.81	62.01	0.894	0.838	0.839	0.161
59	70.82	67.81	0.886	0.825	0.826	0.174
60	77.25	74.03	0.877	0.810	0.812	0.188
61	84.12	80.69	0.868	0.795	0.797	0.203
62	91.44	87.78	0.858	0.780	0.782	0.218
63	99.22	95.33	0.848	0.764	0.765	0.235
64	101.27	100.25	0.842	0.705	0.763	0.237

U0= 5.75 CM/S K= 0.064 1/SEC KLmf/Uo= 1.103

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.01	0.02	4.14	0.462	0.022	677.74
2	0.03	0.02	4.37	0.462	0.022	607.43
3	0.04	0.02	4.62	0.462	0.022	544.41
4	0.07	0.02	4.88	0.462	0.022	487.94
5	0.09	0.03	5.16	0.462	0.022	437.37
6	0.12	0.03	5.45	0.462	0.022	392.02
7	0.15	0.03	5.75	0.462	0.022	351.37
8	0.18	0.03	6.07	0.462	0.022	314.94
9	0.22	0.04	6.42	0.462	0.022	282.31
10	0.26	0.04	6.78	0.462	0.022	253.07
11	0.30	0.05	7.16	0.462	0.022	226.85
12	0.35	0.05	7.56	0.462	0.022	203.37
13	0.41	0.06	7.98	0.462	0.022	182.32
14	0.48	0.07	8.43	0.462	0.022	163.46
15	0.55	0.08	8.91	0.462	0.022	146.55
16	0.63	0.08	9.40	0.462	0.022	131.40
17	0.71	0.09	9.93	0.462	0.022	117.82
18	0.81	0.10	10.49	0.462	0.022	105.66
19	0.92	0.12	11.08	0.462	0.022	94.75
20	1.05	0.13	11.69	0.462	0.022	84.98
21	1.18	0.14	12.35	0.462	0.022	76.23
22	1.34	0.16	13.04	0.462	0.022	68.38
23	1.51	0.18	13.76	0.462	0.022	61.35
24	1.70	0.20	14.53	0.462	0.022	55.05
25	1.91	0.22	15.34	0.462	0.022	49.40
26	2.14	0.25	16.19	0.462	0.022	44.34
27	2.40	0.28	17.09	0.462	0.022	39.80
28	2.70	0.31	18.03	0.462	0.022	35.74
29	3.02	0.34	19.03	0.462	0.022	32.09
30	3.38	0.38	20.08	0.462	0.022	28.83
31	3.79	0.42	21.18	0.462	0.022	25.90
32	4.24	0.47	22.34	0.462	0.022	23.28
33	4.73	0.53	23.56	0.462	0.022	20.93
34	5.29	0.58	24.85	0.462	0.022	18.83
35	5.91	0.65	26.19	0.462	0.022	16.94
36	6.59	0.72	27.61	0.462	0.022	15.25
37	7.35	0.80	29.09	0.462	0.022	13.74
38	8.20	0.89	30.64	0.462	0.022	12.38
39	9.13	0.99	32.27	0.462	0.022	11.16
40	10.17	1.09	33.97	0.462	0.022	10.07
41	11.32	1.21	35.75	0.462	0.022	9.09
42	12.60	1.34	37.61	0.462	0.022	8.22
43	14.01	1.48	39.54	0.462	0.022	7.43
44	15.56	1.63	41.56	0.462	0.022	6.73
45	17.28	1.80	43.65	0.462	0.022	6.10
46	19.18	1.99	45.83	0.462	0.022	5.53
47	21.27	2.19	48.08	0.462	0.022	5.03
48	23.56	2.40	50.41	0.462	0.022	4.57

49	26.09	2.64	52.81	0.462	0.022	4.17
50	28.85	2.89	55.28	0.462	0.022	3.80
51	31.88	3.16	57.82	0.462	0.022	3.48
52	35.19	3.45	60.42	0.462	0.022	3.18
53	38.80	3.76	63.07	0.462	0.022	2.92
54	42.73	4.09	65.77	0.462	0.022	2.69
55	47.00	4.44	68.51	0.462	0.022	2.48
56	51.62	4.81	71.28	0.462	0.022	2.29
57	56.62	5.19	74.07	0.462	0.022	2.12
58	62.01	5.59	76.87	0.462	0.022	1.97
59	67.81	6.01	79.67	0.462	0.022	1.83
60	74.03	6.43	82.46	0.462	0.022	1.71
61	80.69	6.87	85.22	0.462	0.022	1.60
62	87.78	7.32	87.95	0.462	0.022	1.50
63	95.33	7.77	90.63	0.462	0.022	1.42
64	100.25	2.06	46.60	0.685	0.428	5.35

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.01	2.020	0.091	0.03	0.005	0.450	0.451
2	0.03	2.020	0.096	0.03	0.005	0.450	0.451
3	0.04	2.020	0.101	0.03	0.005	0.450	0.451
4	0.07	2.020	0.107	0.03	0.006	0.450	0.451
5	0.09	2.020	0.113	0.03	0.006	0.450	0.451
6	0.12	2.020	0.119	0.04	0.006	0.450	0.451
7	0.15	2.020	0.126	0.04	0.007	0.450	0.451
8	0.18	2.020	0.133	0.04	0.007	0.450	0.451
9	0.22	2.020	0.140	0.04	0.008	0.450	0.452
10	0.26	2.020	0.148	0.05	0.008	0.450	0.452
11	0.30	2.020	0.156	0.05	0.008	0.450	0.452
12	0.35	2.020	0.165	0.05	0.009	0.450	0.452
13	0.41	2.020	0.175	0.05	0.009	0.450	0.452
14	0.48	2.020	0.184	0.06	0.010	0.450	0.452
15	0.55	2.020	0.195	0.06	0.011	0.450	0.452
16	0.63	2.020	0.206	0.06	0.011	0.450	0.452
17	0.71	2.020	0.217	0.07	0.012	0.450	0.452
18	0.81	2.020	0.229	0.07	0.013	0.450	0.453
19	0.92	2.020	0.242	0.07	0.013	0.450	0.453
20	1.05	2.020	0.256	0.08	0.014	0.450	0.453
21	1.18	2.020	0.270	0.08	0.015	0.450	0.453
22	1.34	2.020	0.285	0.09	0.016	0.450	0.453
23	1.51	2.020	0.301	0.09	0.017	0.450	0.453
24	1.70	2.020	0.318	0.10	0.018	0.450	0.454
25	1.91	2.020	0.335	0.10	0.019	0.450	0.454
26	2.14	2.020	0.354	0.11	0.020	0.450	0.454
27	2.40	2.020	0.374	0.12	0.021	0.450	0.454
28	2.70	2.020	0.394	0.12	0.022	0.450	0.455
29	3.02	2.020	0.416	0.13	0.024	0.450	0.455
30	3.38	2.020	0.439	0.14	0.025	0.450	0.455
31	3.79	2.020	0.463	0.14	0.026	0.450	0.455
32	4.24	2.020	0.488	0.15	0.028	0.450	0.456
33	4.73	2.020	0.515	0.16	0.030	0.450	0.456

34	5.29	2.020	0.543	0.17	0.032	0.450	0.456
35	5.91	2.020	0.573	0.18	0.033	0.450	0.457
36	6.59	2.020	0.603	0.19	0.035	0.450	0.457
37	7.35	2.020	0.636	0.20	0.038	0.450	0.458
38	8.20	2.020	0.670	0.21	0.040	0.450	0.458
39	9.13	2.020	0.705	0.22	0.042	0.450	0.459
40	10.17	2.020	0.743	0.23	0.045	0.450	0.459
41	11.32	2.020	0.781	0.24	0.048	0.450	0.460
42	12.60	2.020	0.822	0.25	0.050	0.450	0.460
43	14.01	2.020	0.864	0.27	0.053	0.450	0.461
44	15.56	2.020	0.908	0.28	0.057	0.450	0.462
45	17.28	2.020	0.954	0.29	0.060	0.450	0.463
46	19.18	2.020	1.002	0.31	0.064	0.450	0.463
47	21.27	2.020	1.051	0.32	0.068	0.450	0.464
48	23.56	2.020	1.102	0.34	0.072	0.450	0.465
49	26.09	2.020	1.154	0.36	0.076	0.450	0.466
50	28.85	2.020	1.208	0.37	0.080	0.450	0.467
51	31.88	2.020	1.264	0.39	0.085	0.450	0.468
52	35.19	2.020	1.321	0.41	0.090	0.450	0.469
53	38.80	2.020	1.379	0.43	0.095	0.450	0.470
54	42.73	2.020	1.438	0.44	0.101	0.450	0.471
55	47.00	2.020	1.498	0.46	0.106	0.450	0.473
56	51.62	2.020	1.558	0.48	0.112	0.450	0.474
57	56.62	2.020	1.619	0.50	0.118	0.450	0.475
58	62.01	2.020	1.680	0.52	0.125	0.450	0.477
59	67.81	2.020	1.741	0.54	0.131	0.450	0.478
60	74.03	2.020	1.802	0.56	0.138	0.450	0.480
61	80.69	2.020	1.863	0.58	0.145	0.450	0.481
62	87.78	2.020	1.922	0.59	0.152	0.450	0.483
63	95.33	2.020	1.981	0.61	0.159	0.450	0.485
64	100.25	2.020	19.926	13.46	-0.543	0.450	0.362

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.02	0.01	1.000	1.000	1.000	0.000
2	0.03	0.03	1.000	1.000	1.000	0.000
3	0.05	0.04	1.000	1.000	1.000	0.000
4	0.08	0.07	0.999	1.000	1.000	0.000
5	0.10	0.09	1.000	0.999	0.999	0.001
6	0.13	0.12	0.999	0.999	0.999	0.001
7	0.16	0.15	1.000	0.999	0.999	0.001
8	0.20	0.18	0.998	0.999	0.999	0.001
9	0.24	0.22	0.999	0.999	0.999	0.001
10	0.28	0.26	0.998	0.998	0.998	0.002
11	0.33	0.30	0.999	0.998	0.998	0.002
12	0.38	0.35	0.998	0.998	0.998	0.002
13	0.44	0.41	0.998	0.997	0.997	0.003
14	0.51	0.48	0.997	0.997	0.997	0.003
15	0.58	0.55	0.997	0.996	0.997	0.003
16	0.67	0.63	0.996	0.996	0.996	0.004
17	0.76	0.71	0.996	0.995	0.995	0.005
18	0.87	0.81	0.995	0.995	0.995	0.005

19	0.98	0.92	0.995	0.994	0.994	0.006
20	1.11	1.05	0.994	0.993	0.993	0.007
21	1.26	1.18	0.993	0.992	0.993	0.007
22	1.42	1.34	0.993	0.992	0.992	0.008
23	1.60	1.51	0.992	0.990	0.990	0.010
24	1.80	1.70	0.991	0.989	0.989	0.011
25	2.02	1.91	0.990	0.988	0.988	0.012
26	2.27	2.14	0.988	0.986	0.987	0.013
27	2.54	2.40	0.987	0.985	0.985	0.015
28	2.85	2.70	0.986	0.983	0.983	0.017
29	3.19	3.02	0.984	0.981	0.981	0.019
30	3.57	3.38	0.982	0.979	0.979	0.021
31	4.00	3.79	0.980	0.976	0.976	0.024
32	4.47	4.24	0.978	0.974	0.974	0.026
33	5.00	4.73	0.976	0.970	0.971	0.029
34	5.58	5.29	0.973	0.967	0.967	0.033
35	6.23	5.91	0.970	0.963	0.963	0.037
36	6.95	6.59	0.967	0.959	0.959	0.041
37	7.75	7.35	0.964	0.954	0.955	0.045
38	8.64	8.20	0.960	0.949	0.950	0.050
39	9.63	9.13	0.956	0.944	0.944	0.056
40	10.72	10.17	0.952	0.938	0.938	0.062
41	11.93	11.32	0.947	0.931	0.931	0.069
42	13.27	12.60	0.942	0.923	0.924	0.076
43	14.75	14.01	0.936	0.915	0.916	0.084
44	16.38	15.56	0.930	0.906	0.907	0.093
45	18.19	17.28	0.923	0.897	0.897	0.103
46	20.17	19.18	0.916	0.886	0.887	0.113
47	22.36	21.27	0.909	0.874	0.875	0.125
48	24.77	23.56	0.900	0.862	0.863	0.137
49	27.41	26.09	0.892	0.848	0.849	0.151
50	30.30	28.85	0.882	0.834	0.835	0.165
51	33.46	31.88	0.872	0.818	0.819	0.181
52	36.92	35.19	0.861	0.801	0.803	0.197
53	40.68	38.80	0.850	0.784	0.785	0.215
54	44.78	42.73	0.838	0.765	0.766	0.234
55	49.22	47.00	0.825	0.745	0.747	0.253
56	54.03	51.62	0.812	0.724	0.726	0.274
57	59.22	56.62	0.798	0.702	0.704	0.296
58	64.81	62.01	0.783	0.679	0.681	0.319
59	70.82	67.81	0.767	0.655	0.658	0.342
60	77.25	74.03	0.751	0.631	0.633	0.367
61	84.12	80.69	0.735	0.606	0.608	0.392
62	91.44	87.78	0.718	0.580	0.583	0.417
63	99.22	95.33	0.700	0.554	0.557	0.443
64	101.27	100.25	0.689	0.453	0.554	0.446

U0= 5.75 CM/S K= 0.122 1/SEC KLmf/Uo= 2.102

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.01	0.02	4.14	0.462	0.022	677.74
2	0.03	0.02	4.37	0.462	0.022	607.43
3	0.04	0.02	4.62	0.462	0.022	544.41
4	0.07	0.02	4.88	0.462	0.022	487.94
5	0.09	0.03	5.16	0.462	0.022	437.37
6	0.12	0.03	5.45	0.462	0.022	392.02
7	0.15	0.03	5.75	0.462	0.022	351.37
8	0.18	0.03	6.07	0.462	0.022	314.94
9	0.22	0.04	6.42	0.462	0.022	282.31
10	0.26	0.04	6.79	0.462	0.022	253.07
11	0.30	0.05	7.16	0.462	0.022	226.85
12	0.35	0.05	7.56	0.462	0.022	203.37
13	0.41	0.06	7.98	0.462	0.022	182.32
14	0.48	0.07	8.43	0.462	0.022	163.46
15	0.55	0.08	8.91	0.462	0.022	146.55
16	0.63	0.08	9.40	0.462	0.022	131.40
17	0.71	0.09	9.93	0.462	0.022	117.82
18	0.81	0.10	10.49	0.462	0.022	105.66
19	0.92	0.12	11.08	0.462	0.022	94.75
20	1.05	0.13	11.69	0.462	0.022	84.98
21	1.18	0.14	12.35	0.462	0.022	76.23
22	1.34	0.16	13.04	0.462	0.022	68.38
23	1.51	0.18	13.76	0.462	0.022	61.35
24	1.70	0.20	14.53	0.462	0.022	55.05
25	1.91	0.22	15.34	0.462	0.022	49.40
26	2.14	0.25	16.19	0.462	0.022	44.34
27	2.40	0.28	17.09	0.462	0.022	39.80
28	2.70	0.31	18.03	0.462	0.022	35.74
29	3.02	0.34	19.03	0.462	0.022	32.09
30	3.38	0.38	20.08	0.462	0.022	28.83
31	3.79	0.42	21.18	0.462	0.022	25.90
32	4.24	0.47	22.34	0.462	0.022	23.28
33	4.73	0.53	23.56	0.462	0.022	20.93
34	5.29	0.58	24.85	0.462	0.022	18.83
35	5.91	0.65	26.19	0.462	0.022	16.94
36	6.59	0.72	27.61	0.462	0.022	15.25
37	7.35	0.80	29.09	0.462	0.022	13.74
38	8.20	0.89	30.64	0.462	0.022	12.38
39	9.13	0.99	32.27	0.462	0.022	11.16
40	10.17	1.09	33.97	0.462	0.022	10.07
41	11.32	1.21	35.75	0.462	0.022	9.09
42	12.60	1.34	37.61	0.462	0.022	8.22
43	14.01	1.48	39.54	0.462	0.022	7.43
44	15.56	1.63	41.56	0.462	0.022	6.73
45	17.28	1.80	43.65	0.462	0.022	6.10
46	19.18	1.99	45.83	0.462	0.022	5.53
47	21.27	2.19	48.08	0.462	0.022	5.03

48	23.56	2.40	50.41	0.462	0.022	4.57
49	26.09	2.64	52.81	0.462	0.022	4.17
50	28.85	2.89	55.28	0.462	0.022	3.80
51	31.88	3.16	57.82	0.462	0.022	3.48
52	35.19	3.45	60.42	0.462	0.022	3.18
53	38.80	3.76	63.07	0.462	0.022	2.92
54	42.73	4.09	65.77	0.462	0.022	2.69
55	47.00	4.44	68.51	0.462	0.022	2.48
56	51.62	4.81	71.28	0.462	0.022	2.29
57	56.62	5.19	74.07	0.462	0.022	2.12
58	62.01	5.59	76.87	0.462	0.022	1.97
59	67.81	6.01	79.67	0.462	0.022	1.83
60	74.03	6.43	82.46	0.462	0.022	1.71
61	80.69	6.87	85.22	0.462	0.022	1.60
62	87.78	7.32	87.95	0.462	0.022	1.50
63	95.33	7.77	90.63	0.462	0.022	1.42
64	100.25	2.06	46.60	0.685	0.428	5.35

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.01	2.020	0.091	0.03	0.005	0.450	0.451
2	0.03	2.020	0.096	0.03	0.005	0.450	0.451
3	0.04	2.020	0.101	0.03	0.005	0.450	0.451
4	0.07	2.020	0.107	0.03	0.006	0.450	0.451
5	0.09	2.020	0.113	0.03	0.006	0.450	0.451
6	0.12	2.020	0.119	0.04	0.006	0.450	0.451
7	0.15	2.020	0.126	0.04	0.007	0.450	0.451
8	0.18	2.020	0.133	0.04	0.007	0.450	0.451
9	0.22	2.020	0.140	0.04	0.008	0.450	0.452
10	0.26	2.020	0.148	0.05	0.008	0.450	0.452
11	0.30	2.020	0.156	0.05	0.008	0.450	0.452
12	0.35	2.020	0.165	0.05	0.009	0.450	0.452
13	0.41	2.020	0.175	0.05	0.009	0.450	0.452
14	0.48	2.020	0.184	0.06	0.010	0.450	0.452
15	0.55	2.020	0.195	0.06	0.011	0.450	0.452
16	0.63	2.020	0.206	0.06	0.011	0.450	0.452
17	0.71	2.020	0.217	0.07	0.012	0.450	0.452
18	0.81	2.020	0.229	0.07	0.013	0.450	0.453
19	0.92	2.020	0.242	0.07	0.013	0.450	0.453
20	1.05	2.020	0.256	0.08	0.014	0.450	0.453
21	1.18	2.020	0.270	0.08	0.015	0.450	0.453
22	1.34	2.020	0.285	0.09	0.016	0.450	0.453
23	1.51	2.020	0.301	0.09	0.017	0.450	0.453
24	1.70	2.020	0.318	0.10	0.018	0.450	0.454
25	1.91	2.020	0.335	0.10	0.019	0.450	0.454
26	2.14	2.020	0.354	0.11	0.020	0.450	0.454
27	2.40	2.020	0.374	0.12	0.021	0.450	0.454
28	2.70	2.020	0.394	0.12	0.022	0.450	0.455
29	3.02	2.020	0.416	0.13	0.024	0.450	0.455
30	3.38	2.020	0.439	0.14	0.025	0.450	0.455
31	3.79	2.020	0.463	0.14	0.026	0.450	0.455
32	4.24	2.020	0.488	0.15	0.028	0.450	0.456

33	4.73	2.020	0.515	0.16	0.030	0.450	0.456
34	5.29	2.020	0.543	0.17	0.032	0.450	0.456
35	5.91	2.020	0.573	0.18	0.033	0.450	0.457
36	6.59	2.020	0.603	0.19	0.035	0.450	0.457
37	7.35	2.020	0.636	0.20	0.038	0.450	0.458
38	8.20	2.020	0.670	0.21	0.040	0.450	0.458
39	9.13	2.020	0.705	0.22	0.042	0.450	0.459
40	10.17	2.020	0.743	0.23	0.045	0.450	0.459
41	11.32	2.020	0.781	0.24	0.048	0.450	0.460
42	12.60	2.020	0.822	0.25	0.050	0.450	0.460
43	14.01	2.020	0.864	0.27	0.053	0.450	0.461
44	15.56	2.020	0.908	0.28	0.057	0.450	0.462
45	17.28	2.020	0.954	0.29	0.060	0.450	0.463
46	19.18	2.020	1.002	0.31	0.064	0.450	0.463
47	21.27	2.020	1.051	0.32	0.068	0.450	0.464
48	23.56	2.020	1.102	0.34	0.072	0.450	0.465
49	26.09	2.020	1.154	0.36	0.076	0.450	0.466
50	28.85	2.020	1.208	0.37	0.080	0.450	0.467
51	31.88	2.020	1.264	0.39	0.085	0.450	0.468
52	35.19	2.020	1.321	0.41	0.090	0.450	0.469
53	38.80	2.020	1.379	0.43	0.095	0.450	0.470
54	42.73	2.020	1.438	0.44	0.101	0.450	0.471
55	47.00	2.020	1.498	0.46	0.106	0.450	0.473
56	51.62	2.020	1.558	0.48	0.112	0.450	0.474
57	56.62	2.020	1.619	0.50	0.118	0.450	0.475
58	62.01	2.020	1.680	0.52	0.125	0.450	0.477
59	67.81	2.020	1.741	0.54	0.131	0.450	0.478
60	74.03	2.020	1.802	0.56	0.138	0.450	0.480
61	80.69	2.020	1.863	0.58	0.145	0.450	0.481
62	87.78	2.020	1.922	0.59	0.152	0.450	0.483
63	95.33	2.020	1.981	0.61	0.159	0.450	0.485
64	100.25	2.020	19.926	13.46	-0.543	0.450	0.362

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.02	0.01	1.000	1.000	1.000	0.000
2	0.03	0.03	0.999	1.000	1.000	0.000
3	0.05	0.04	1.000	0.999	0.999	0.001
4	0.08	0.07	0.999	0.999	0.999	0.001
5	0.10	0.09	1.000	0.999	0.999	0.001
6	0.13	0.12	0.998	0.999	0.999	0.001
7	0.16	0.15	1.000	0.998	0.998	0.002
8	0.20	0.18	0.997	0.998	0.998	0.002
9	0.24	0.22	0.999	0.997	0.997	0.003
10	0.28	0.26	0.996	0.997	0.997	0.003
11	0.33	0.30	0.997	0.996	0.996	0.004
12	0.38	0.35	0.995	0.996	0.996	0.004
13	0.44	0.41	0.996	0.995	0.995	0.005
14	0.51	0.48	0.995	0.994	0.994	0.006
15	0.58	0.55	0.994	0.993	0.993	0.007
16	0.67	0.63	0.993	0.992	0.992	0.008
17	0.76	0.71	0.992	0.991	0.991	0.009

18	0.87	0.81	0.991	0.990	0.990	0.010
19	0.98	0.92	0.990	0.989	0.989	0.011
20	1.11	1.05	0.989	0.987	0.987	0.013
21	1.26	1.18	0.987	0.986	0.986	0.014
22	1.42	1.34	0.986	0.984	0.984	0.016
23	1.60	1.51	0.984	0.982	0.982	0.018
24	1.80	1.70	0.982	0.980	0.980	0.020
25	2.02	1.91	0.980	0.977	0.977	0.023
26	2.27	2.14	0.978	0.974	0.974	0.026
27	2.54	2.40	0.975	0.971	0.971	0.029
28	2.85	2.70	0.973	0.968	0.968	0.032
29	3.19	3.02	0.970	0.964	0.964	0.036
30	3.57	3.38	0.966	0.960	0.960	0.040
31	4.00	3.79	0.963	0.955	0.955	0.045
32	4.47	4.24	0.959	0.950	0.950	0.050
33	5.00	4.73	0.954	0.944	0.945	0.055
34	5.58	5.29	0.949	0.938	0.938	0.062
35	6.23	5.91	0.944	0.931	0.931	0.069
36	6.95	6.59	0.938	0.924	0.924	0.076
37	7.75	7.35	0.932	0.915	0.916	0.084
38	8.64	8.20	0.925	0.906	0.906	0.094
39	9.63	9.13	0.918	0.896	0.896	0.104
40	10.72	10.17	0.910	0.885	0.885	0.115
41	11.93	11.32	0.901	0.873	0.873	0.127
42	13.27	12.60	0.892	0.859	0.860	0.140
43	14.75	14.01	0.882	0.845	0.846	0.154
44	16.38	15.56	0.871	0.829	0.830	0.170
45	18.19	17.28	0.860	0.813	0.814	0.186
46	20.17	19.18	0.847	0.794	0.796	0.204
47	22.36	21.27	0.834	0.775	0.776	0.224
48	24.77	23.56	0.820	0.754	0.755	0.245
49	27.41	26.09	0.805	0.732	0.733	0.267
50	30.30	28.85	0.789	0.708	0.710	0.290
51	33.46	31.88	0.772	0.683	0.685	0.315
52	36.92	35.19	0.754	0.657	0.659	0.341
53	40.68	38.80	0.736	0.630	0.632	0.368
54	44.78	42.73	0.717	0.602	0.604	0.396
55	49.22	47.00	0.697	0.573	0.575	0.425
56	54.03	51.62	0.676	0.543	0.545	0.455
57	59.22	56.62	0.654	0.512	0.515	0.485
58	64.81	62.01	0.632	0.481	0.484	0.516
59	70.82	67.81	0.610	0.450	0.454	0.546
60	77.25	74.03	0.587	0.419	0.423	0.577
61	84.12	80.69	0.564	0.388	0.392	0.608
62	91.44	87.78	0.541	0.358	0.362	0.638
63	99.22	95.33	0.517	0.329	0.333	0.667
64	101.27	100.25	0.503	0.202	0.330	0.670

U0= 5.75 CM/S K= 0.302 1/SEC KLmf/Uo= 5.203

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.01	0.02	4.14	0.462	0.022	677.74
2	0.03	0.02	4.37	0.462	0.022	607.43
3	0.04	0.02	4.62	0.462	0.022	544.41
4	0.07	0.02	4.88	0.462	0.022	487.94
5	0.09	0.03	5.16	0.462	0.022	437.37
6	0.12	0.03	5.45	0.462	0.022	392.02
7	0.15	0.03	5.75	0.462	0.022	351.37
8	0.18	0.03	6.07	0.462	0.022	314.94
9	0.22	0.04	6.42	0.462	0.022	282.31
10	0.26	0.04	6.78	0.462	0.022	253.07
11	0.30	0.05	7.16	0.462	0.022	226.85
12	0.35	0.05	7.56	0.462	0.022	203.37
13	0.41	0.06	7.98	0.462	0.022	182.32
14	0.48	0.07	8.43	0.462	0.022	163.46
15	0.55	0.08	8.91	0.462	0.022	146.55
16	0.63	0.08	9.40	0.462	0.022	131.40
17	0.71	0.09	9.93	0.462	0.022	117.82
18	0.81	0.10	10.49	0.462	0.022	105.66
19	0.92	0.12	11.08	0.462	0.022	94.75
20	1.05	0.13	11.69	0.462	0.022	84.98
21	1.18	0.14	12.35	0.462	0.022	76.23
22	1.34	0.16	13.04	0.462	0.022	68.38
23	1.51	0.18	13.76	0.462	0.022	61.35
24	1.70	0.20	14.53	0.462	0.022	55.05
25	1.91	0.22	15.34	0.462	0.022	49.40
26	2.14	0.25	16.19	0.462	0.022	44.34
27	2.40	0.28	17.09	0.462	0.022	39.80
28	2.70	0.31	18.03	0.462	0.022	35.74
29	3.02	0.34	19.03	0.462	0.022	32.09
30	3.38	0.38	20.08	0.462	0.022	28.83
31	3.79	0.42	21.18	0.462	0.022	25.90
32	4.24	0.47	22.34	0.462	0.022	23.28
33	4.73	0.53	23.56	0.462	0.022	20.93
34	5.29	0.58	24.85	0.462	0.022	18.83
35	5.91	0.65	26.19	0.462	0.022	16.94
36	6.59	0.72	27.61	0.462	0.022	15.25
37	7.35	0.80	29.09	0.462	0.022	13.74
38	8.20	0.89	30.64	0.462	0.022	12.38
39	9.13	0.99	32.27	0.462	0.022	11.16
40	10.17	1.09	33.97	0.462	0.022	10.07
41	11.32	1.21	35.75	0.462	0.022	9.09
42	12.60	1.34	37.61	0.462	0.022	8.22
43	14.01	1.48	39.54	0.462	0.022	7.43
44	15.56	1.63	41.56	0.462	0.022	6.73
45	17.28	1.80	43.65	0.462	0.022	6.10
46	19.18	1.99	45.83	0.462	0.022	5.53
47	21.27	2.19	48.08	0.462	0.022	5.03
48	23.56	2.40	50.41	0.462	0.022	4.57

49	26.09	2.64	52.81	0.462	0.022	4.17
50	28.85	2.89	55.28	0.462	0.022	3.80
51	31.88	3.16	57.82	0.462	0.022	3.48
52	35.19	3.45	60.42	0.462	0.022	3.18
53	38.80	3.76	63.07	0.462	0.022	2.92
54	42.73	4.09	65.77	0.462	0.022	2.69
55	47.00	4.44	68.51	0.462	0.022	2.48
56	51.62	4.81	71.28	0.462	0.022	2.29
57	56.62	5.19	74.07	0.462	0.022	2.12
58	62.01	5.59	76.87	0.462	0.022	1.97
59	67.81	6.01	79.67	0.462	0.022	1.83
60	74.03	6.43	82.46	0.462	0.022	1.71
61	80.69	6.87	85.22	0.462	0.022	1.60
62	87.78	7.32	87.95	0.462	0.022	1.50
63	95.33	7.77	90.63	0.462	0.022	1.42
64	100.25	2.06	46.60	0.685	0.428	5.35

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.01	2.020	0.091	0.03	0.005	0.450	0.451
2	0.03	2.020	0.096	0.03	0.005	0.450	0.451
3	0.04	2.020	0.101	0.03	0.005	0.450	0.451
4	0.07	2.020	0.107	0.03	0.006	0.450	0.451
5	0.09	2.020	0.113	0.03	0.006	0.450	0.451
6	0.12	2.020	0.119	0.04	0.006	0.450	0.451
7	0.15	2.020	0.126	0.04	0.007	0.450	0.451
8	0.18	2.020	0.133	0.04	0.007	0.450	0.451
9	0.22	2.020	0.140	0.04	0.008	0.450	0.452
10	0.26	2.020	0.148	0.05	0.008	0.450	0.452
11	0.30	2.020	0.156	0.05	0.008	0.450	0.452
12	0.35	2.020	0.165	0.05	0.009	0.450	0.452
13	0.41	2.020	0.175	0.05	0.009	0.450	0.452
14	0.48	2.020	0.184	0.06	0.010	0.450	0.452
15	0.55	2.020	0.195	0.06	0.011	0.450	0.452
16	0.63	2.020	0.206	0.06	0.011	0.450	0.452
17	0.71	2.020	0.217	0.07	0.012	0.450	0.452
18	0.81	2.020	0.229	0.07	0.013	0.450	0.453
19	0.92	2.020	0.242	0.07	0.013	0.450	0.453
20	1.05	2.020	0.256	0.08	0.014	0.450	0.453
21	1.18	2.020	0.270	0.08	0.015	0.450	0.453
22	1.34	2.020	0.285	0.09	0.016	0.450	0.453
23	1.51	2.020	0.301	0.09	0.017	0.450	0.453
24	1.70	2.020	0.318	0.10	0.018	0.450	0.454
25	1.91	2.020	0.335	0.10	0.019	0.450	0.454
26	2.14	2.020	0.354	0.11	0.020	0.450	0.454
27	2.40	2.020	0.374	0.12	0.021	0.450	0.454
28	2.70	2.020	0.394	0.12	0.022	0.450	0.455
29	3.02	2.020	0.416	0.13	0.024	0.450	0.455
30	3.38	2.020	0.439	0.14	0.025	0.450	0.455
31	3.79	2.020	0.463	0.14	0.026	0.450	0.455
32	4.24	2.020	0.488	0.15	0.028	0.450	0.456
33	4.73	2.020	0.515	0.16	0.030	0.450	0.456

34	5.29	2.020	0.543	0.17	0.032	0.450	0.456
35	5.91	2.020	0.573	0.18	0.033	0.450	0.457
36	6.59	2.020	0.603	0.19	0.035	0.450	0.457
37	7.35	2.020	0.636	0.20	0.038	0.450	0.458
38	8.20	2.020	0.670	0.21	0.040	0.450	0.458
39	9.13	2.020	0.705	0.22	0.042	0.450	0.459
40	10.17	2.020	0.743	0.23	0.045	0.450	0.459
41	11.32	2.020	0.781	0.24	0.048	0.450	0.460
42	12.60	2.020	0.822	0.25	0.050	0.450	0.460
43	14.01	2.020	0.864	0.27	0.053	0.450	0.461
44	15.56	2.020	0.908	0.28	0.057	0.450	0.462
45	17.28	2.020	0.954	0.29	0.060	0.450	0.463
46	19.18	2.020	1.002	0.31	0.064	0.450	0.463
47	21.27	2.020	1.051	0.32	0.068	0.450	0.464
48	23.56	2.020	1.102	0.34	0.072	0.450	0.465
49	26.09	2.020	1.154	0.36	0.076	0.450	0.466
50	28.85	2.020	1.208	0.37	0.080	0.450	0.467
51	31.88	2.020	1.264	0.39	0.085	0.450	0.468
52	35.19	2.020	1.321	0.41	0.090	0.450	0.469
53	38.80	2.020	1.379	0.43	0.095	0.450	0.470
54	42.73	2.020	1.438	0.44	0.101	0.450	0.471
55	47.00	2.020	1.498	0.46	0.106	0.450	0.473
56	51.62	2.020	1.558	0.48	0.112	0.450	0.474
57	56.62	2.020	1.619	0.50	0.118	0.450	0.475
58	62.01	2.020	1.680	0.52	0.125	0.450	0.477
59	67.81	2.020	1.741	0.54	0.131	0.450	0.478
60	74.03	2.020	1.802	0.56	0.138	0.450	0.480
61	80.69	2.020	1.863	0.58	0.145	0.450	0.481
62	87.78	2.020	1.922	0.59	0.152	0.450	0.483
63	95.33	2.020	1.981	0.61	0.159	0.450	0.485
64	100.25	2.020	19.926	13.46	-0.543	0.450	0.362

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.02	0.01	1.000	1.000	1.000	0.000
2	0.03	0.03	0.999	0.999	0.999	0.001
3	0.05	0.04	1.000	0.998	0.998	0.002
4	0.08	0.07	0.997	0.998	0.998	0.002
5	0.10	0.09	1.000	0.997	0.997	0.003
6	0.13	0.12	0.994	0.996	0.996	0.004
7	0.16	0.15	0.999	0.995	0.995	0.005
8	0.20	0.18	0.991	0.995	0.994	0.006
9	0.24	0.22	0.997	0.993	0.993	0.007
10	0.28	0.26	0.990	0.992	0.992	0.008
11	0.33	0.30	0.994	0.991	0.991	0.009
12	0.38	0.35	0.989	0.989	0.989	0.011
13	0.44	0.41	0.990	0.988	0.988	0.012
14	0.51	0.48	0.987	0.986	0.986	0.014
15	0.58	0.55	0.985	0.984	0.984	0.016
16	0.67	0.63	0.983	0.981	0.981	0.019
17	0.76	0.71	0.981	0.979	0.979	0.021
18	0.87	0.81	0.978	0.976	0.976	0.024

19	0.98	0.92	0.976	0.973	0.973	0.027
20	1.11	1.05	0.972	0.969	0.969	0.031
21	1.26	1.18	0.969	0.965	0.965	0.035
22	1.42	1.34	0.965	0.961	0.961	0.039
23	1.60	1.51	0.961	0.956	0.956	0.044
24	1.80	1.70	0.957	0.950	0.951	0.049
25	2.02	1.91	0.952	0.945	0.945	0.055
26	2.27	2.14	0.946	0.938	0.938	0.062
27	2.54	2.40	0.940	0.931	0.931	0.069
28	2.85	2.70	0.934	0.923	0.923	0.077
29	3.19	3.02	0.927	0.914	0.914	0.086
30	3.57	3.38	0.919	0.904	0.904	0.096
31	4.00	3.79	0.910	0.893	0.894	0.106
32	4.47	4.24	0.901	0.881	0.882	0.118
33	5.00	4.73	0.891	0.868	0.869	0.131
34	5.58	5.29	0.880	0.854	0.855	0.145
35	6.23	5.91	0.868	0.839	0.839	0.161
36	6.95	6.59	0.855	0.822	0.823	0.177
37	7.75	7.35	0.841	0.804	0.804	0.196
38	8.64	8.20	0.826	0.784	0.785	0.215
39	9.63	9.13	0.810	0.762	0.764	0.236
40	10.72	10.17	0.793	0.740	0.741	0.259
41	11.93	11.32	0.775	0.715	0.716	0.284
42	13.27	12.60	0.755	0.689	0.690	0.310
43	14.75	14.01	0.735	0.661	0.663	0.337
44	16.38	15.56	0.713	0.632	0.633	0.367
45	18.19	17.28	0.690	0.601	0.603	0.397
46	20.17	19.18	0.667	0.569	0.571	0.429
47	22.36	21.27	0.642	0.535	0.538	0.462
48	24.77	23.56	0.616	0.501	0.504	0.496
49	27.41	26.09	0.590	0.466	0.469	0.531
50	30.30	28.85	0.563	0.431	0.434	0.566
51	33.46	31.88	0.535	0.395	0.398	0.602
52	36.92	35.19	0.508	0.360	0.363	0.637
53	40.68	38.80	0.479	0.325	0.329	0.671
54	44.78	42.73	0.451	0.291	0.295	0.705
55	49.22	47.00	0.424	0.259	0.262	0.738
56	54.03	51.62	0.396	0.228	0.231	0.769
57	59.22	56.62	0.369	0.199	0.202	0.798
58	64.81	62.01	0.343	0.171	0.175	0.825
59	70.82	67.81	0.317	0.147	0.150	0.850
60	77.25	74.03	0.293	0.124	0.128	0.872
61	84.12	80.69	0.270	0.104	0.108	0.892
62	91.44	87.78	0.248	0.086	0.090	0.910
63	99.22	95.33	0.227	0.071	0.074	0.926
64	101.27	100.25	0.215	-0.029	0.075	0.925

UO= 5.75 CM/S K= 0.668 1/SEC KLmf/Uo=11.508

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.01	0.02	4.14	0.462	0.022	677.74
2	0.03	0.02	4.37	0.462	0.022	607.43
3	0.04	0.02	4.62	0.462	0.022	544.41
4	0.07	0.02	4.88	0.462	0.022	487.94
5	0.09	0.03	5.16	0.462	0.022	437.37
6	0.12	0.03	5.45	0.462	0.022	392.02
7	0.15	0.03	5.75	0.462	0.022	351.37
8	0.18	0.03	6.07	0.462	0.022	314.94
9	0.22	0.04	6.42	0.462	0.022	282.31
10	0.26	0.04	6.78	0.462	0.022	253.07
11	0.30	0.05	7.16	0.462	0.022	226.85
12	0.35	0.05	7.56	0.462	0.022	203.37
13	0.41	0.06	7.98	0.462	0.022	182.32
14	0.48	0.07	8.43	0.462	0.022	163.46
15	0.55	0.08	8.91	0.462	0.022	146.55
16	0.63	0.08	9.40	0.462	0.022	131.40
17	0.71	0.09	9.93	0.462	0.022	117.82
18	0.81	0.10	10.49	0.462	0.022	105.66
19	0.92	0.12	11.08	0.462	0.022	94.75
20	1.05	0.13	11.69	0.462	0.022	84.98
21	1.18	0.14	12.35	0.462	0.022	76.23
22	1.34	0.16	13.04	0.462	0.022	68.38
23	1.51	0.18	13.76	0.462	0.022	61.35
24	1.70	0.20	14.53	0.462	0.022	55.05
25	1.91	0.22	15.34	0.462	0.022	49.40
26	2.14	0.25	16.19	0.462	0.022	44.34
27	2.40	0.28	17.09	0.462	0.022	39.80
28	2.70	0.31	18.03	0.462	0.022	35.74
29	3.02	0.34	19.03	0.462	0.022	32.09
30	3.38	0.38	20.08	0.462	0.022	28.83
31	3.79	0.42	21.18	0.462	0.022	25.90
32	4.24	0.47	22.34	0.462	0.022	23.28
33	4.73	0.53	23.56	0.462	0.022	20.93
34	5.29	0.58	24.85	0.462	0.022	18.83
35	5.91	0.65	26.19	0.462	0.022	16.94
36	6.59	0.72	27.61	0.462	0.022	15.25
37	7.35	0.80	29.09	0.462	0.022	13.74
38	8.20	0.89	30.64	0.462	0.022	12.38
39	9.13	0.99	32.27	0.462	0.022	11.16
40	10.17	1.09	33.97	0.462	0.022	10.07
41	11.32	1.21	35.75	0.462	0.022	9.09
42	12.60	1.34	37.61	0.462	0.022	8.22
43	14.01	1.48	39.54	0.462	0.022	7.43
44	15.56	1.63	41.56	0.462	0.022	6.73
45	17.28	1.80	43.65	0.462	0.022	6.10
46	19.18	1.99	45.83	0.462	0.022	5.53

47	21.27	2.19	48.08	0.462	0.022	5.03
48	23.56	2.40	50.41	0.462	0.022	4.57
49	26.09	2.64	52.81	0.462	0.022	4.17
50	28.85	2.89	55.28	0.462	0.022	3.80
51	31.88	3.16	57.82	0.462	0.022	3.48
52	35.19	3.45	60.42	0.462	0.022	3.18
53	38.80	3.76	63.07	0.462	0.022	2.92
54	42.73	4.09	65.77	0.462	0.022	2.69
55	47.00	4.44	68.51	0.462	0.022	2.48
56	51.62	4.81	71.28	0.462	0.022	2.29
57	56.62	5.19	74.07	0.462	0.022	2.12
58	62.01	5.59	76.87	0.462	0.022	1.97
59	67.81	6.01	79.67	0.462	0.022	1.83
60	74.03	6.43	82.46	0.462	0.022	1.71
61	80.69	6.87	85.22	0.462	0.022	1.60
62	87.78	7.32	87.95	0.462	0.022	1.50
63	95.33	7.77	90.63	0.462	0.022	1.42
64	100.25	2.06	46.60	0.685	0.428	5.35

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.01	2.020	0.091	0.03	0.005	0.450	0.451
2	0.03	2.020	0.096	0.03	0.005	0.450	0.451
3	0.04	2.020	0.101	0.03	0.005	0.450	0.451
4	0.07	2.020	0.107	0.03	0.006	0.450	0.451
5	0.09	2.020	0.113	0.03	0.006	0.450	0.451
6	0.12	2.020	0.119	0.04	0.006	0.450	0.451
7	0.15	2.020	0.126	0.04	0.007	0.450	0.451
8	0.18	2.020	0.133	0.04	0.007	0.450	0.451
9	0.22	2.020	0.140	0.04	0.008	0.450	0.452
10	0.26	2.020	0.148	0.05	0.008	0.450	0.452
11	0.30	2.020	0.156	0.05	0.008	0.450	0.452
12	0.35	2.020	0.165	0.05	0.009	0.450	0.452
13	0.41	2.020	0.175	0.05	0.009	0.450	0.452
14	0.48	2.020	0.184	0.06	0.010	0.450	0.452
15	0.55	2.020	0.195	0.06	0.011	0.450	0.452
16	0.63	2.020	0.206	0.06	0.011	0.450	0.452
17	0.71	2.020	0.217	0.07	0.012	0.450	0.452
18	0.81	2.020	0.229	0.07	0.013	0.450	0.453
19	0.92	2.020	0.242	0.07	0.013	0.450	0.453
20	1.05	2.020	0.256	0.08	0.014	0.450	0.453
21	1.18	2.020	0.270	0.08	0.015	0.450	0.453
22	1.34	2.020	0.285	0.09	0.016	0.450	0.453
23	1.51	2.020	0.301	0.09	0.017	0.450	0.453
24	1.70	2.020	0.318	0.10	0.018	0.450	0.454
25	1.91	2.020	0.335	0.10	0.019	0.450	0.454
26	2.14	2.020	0.354	0.11	0.020	0.450	0.454
27	2.40	2.020	0.374	0.12	0.021	0.450	0.454
28	2.70	2.020	0.394	0.12	0.022	0.450	0.455
29	3.02	2.020	0.416	0.13	0.024	0.450	0.455
30	3.38	2.020	0.439	0.14	0.025	0.450	0.455
31	3.79	2.020	0.463	0.14	0.026	0.450	0.455

32	4.24	2.020	0.488	0.15	0.028	0.450	0.456
33	4.73	2.020	0.515	0.16	0.030	0.450	0.456
34	5.29	2.020	0.543	0.17	0.032	0.450	0.456
35	5.91	2.020	0.573	0.18	0.033	0.450	0.457
36	6.59	2.020	0.603	0.19	0.035	0.450	0.457
37	7.35	2.020	0.636	0.20	0.038	0.450	0.458
38	8.20	2.020	0.670	0.21	0.040	0.450	0.458
39	9.13	2.020	0.705	0.22	0.042	0.450	0.459
40	10.17	2.020	0.743	0.23	0.045	0.450	0.459
41	11.32	2.020	0.781	0.24	0.048	0.450	0.460
42	12.60	2.020	0.822	0.25	0.050	0.450	0.460
43	14.01	2.020	0.864	0.27	0.053	0.450	0.461
44	15.56	2.020	0.908	0.28	0.057	0.450	0.462
45	17.28	2.020	0.954	0.29	0.060	0.450	0.463
46	19.18	2.020	1.002	0.31	0.064	0.450	0.463
47	21.27	2.020	1.051	0.32	0.068	0.450	0.464
48	23.56	2.020	1.102	0.34	0.072	0.450	0.465
49	26.09	2.020	1.154	0.36	0.076	0.450	0.466
50	28.85	2.020	1.208	0.37	0.080	0.450	0.467
51	31.88	2.020	1.264	0.39	0.085	0.450	0.468
52	35.19	2.020	1.321	0.41	0.090	0.450	0.469
53	38.80	2.020	1.379	0.43	0.095	0.450	0.470
54	42.73	2.020	1.438	0.44	0.101	0.450	0.471
55	47.00	2.020	1.498	0.46	0.106	0.450	0.473
56	51.62	2.020	1.558	0.48	0.112	0.450	0.474
57	56.62	2.020	1.619	0.50	0.118	0.450	0.475
58	62.01	2.020	1.680	0.52	0.125	0.450	0.477
59	67.81	2.020	1.741	0.54	0.131	0.450	0.478
60	74.03	2.020	1.802	0.56	0.138	0.450	0.480
61	80.69	2.020	1.863	0.58	0.145	0.450	0.481
62	87.78	2.020	1.922	0.59	0.152	0.450	0.483
63	95.33	2.020	1.981	0.61	0.159	0.450	0.485
64	100.25	2.020	19.926	13.46	-0.543	0.450	0.362

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.02	0.01	1.000	0.999	0.999	0.001
2	0.03	0.03	0.997	0.998	0.998	0.002
3	0.05	0.04	0.999	0.997	0.997	0.003
4	0.08	0.07	0.993	0.995	0.995	0.005
5	0.10	0.09	0.999	0.994	0.994	0.006
6	0.13	0.12	0.987	0.992	0.992	0.008
7	0.16	0.15	0.998	0.990	0.990	0.010
8	0.20	0.18	0.981	0.988	0.988	0.012
9	0.24	0.22	0.994	0.985	0.985	0.015
10	0.28	0.26	0.978	0.983	0.983	0.017
11	0.33	0.30	0.986	0.980	0.980	0.020
12	0.38	0.35	0.975	0.976	0.976	0.024
13	0.44	0.41	0.977	0.973	0.973	0.027
14	0.51	0.48	0.971	0.969	0.969	0.031
15	0.58	0.55	0.968	0.964	0.964	0.036
16	0.67	0.63	0.963	0.959	0.959	0.041

17	0.76	0.71	0.958	0.954	0.954	0.046
18	0.87	0.81	0.953	0.947	0.947	0.053
19	0.98	0.92	0.947	0.940	0.941	0.059
20	1.11	1.05	0.940	0.933	0.933	0.067
21	1.26	1.18	0.933	0.925	0.925	0.075
22	1.42	1.34	0.925	0.915	0.916	0.084
23	1.60	1.51	0.916	0.905	0.905	0.095
24	1.80	1.70	0.907	0.894	0.894	0.106
25	2.02	1.91	0.897	0.882	0.882	0.118
26	2.27	2.14	0.885	0.868	0.869	0.131
27	2.54	2.40	0.873	0.853	0.854	0.146
28	2.85	2.70	0.860	0.837	0.838	0.162
29	3.19	3.02	0.845	0.820	0.820	0.180
30	3.57	3.38	0.830	0.800	0.801	0.199
31	4.00	3.79	0.813	0.780	0.780	0.220
32	4.47	4.24	0.795	0.757	0.758	0.242
33	5.00	4.73	0.775	0.733	0.734	0.266
34	5.58	5.29	0.754	0.707	0.708	0.292
35	6.23	5.91	0.732	0.679	0.681	0.319
36	6.95	6.59	0.709	0.650	0.651	0.349
37	7.75	7.35	0.684	0.619	0.620	0.380
38	8.64	8.20	0.658	0.586	0.588	0.412
39	9.63	9.13	0.631	0.552	0.554	0.446
40	10.72	10.17	0.602	0.517	0.518	0.482
41	11.93	11.32	0.573	0.480	0.482	0.518
42	13.27	12.60	0.543	0.443	0.445	0.555
43	14.75	14.01	0.512	0.405	0.408	0.592
44	16.38	15.56	0.481	0.368	0.370	0.630
45	18.19	17.28	0.449	0.330	0.333	0.667
46	20.17	19.18	0.418	0.294	0.296	0.704
47	22.36	21.27	0.386	0.258	0.261	0.739
48	24.77	23.56	0.356	0.224	0.227	0.773
49	27.41	26.09	0.326	0.193	0.196	0.804
50	30.30	28.85	0.297	0.163	0.166	0.834
51	33.46	31.88	0.269	0.136	0.139	0.861
52	36.92	35.19	0.242	0.112	0.115	0.885
53	40.68	38.80	0.218	0.091	0.094	0.906
54	44.78	42.73	0.195	0.072	0.075	0.925
55	49.22	47.00	0.173	0.057	0.059	0.941
56	54.03	51.62	0.154	0.044	0.046	0.954
57	59.22	56.62	0.136	0.033	0.035	0.965
58	64.81	62.01	0.120	0.025	0.027	0.973
59	70.82	67.81	0.106	0.018	0.020	0.980
60	77.25	74.03	0.093	0.013	0.015	0.985
61	84.12	80.69	0.082	0.009	0.011	0.989
62	91.44	87.78	0.073	0.006	0.008	0.992
63	99.22	95.33	0.064	0.004	0.006	0.994
64	101.27	100.25	0.059	-0.030	0.008	0.992

U0= 5.75 CM/S K= 1.248 1/SEC KLmf/Uo=21.500

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.01	0.02	4.14	0.462	0.022	677.74
2	0.03	0.02	4.37	0.462	0.022	607.43
3	0.04	0.02	4.62	0.462	0.022	544.41
4	0.07	0.02	4.88	0.462	0.022	487.94
5	0.09	0.03	5.16	0.462	0.022	437.37
6	0.12	0.03	5.45	0.462	0.022	392.02
7	0.15	0.03	5.75	0.462	0.022	351.37
8	0.18	0.03	6.07	0.462	0.022	314.94
9	0.22	0.04	6.42	0.462	0.022	282.31
10	0.26	0.04	6.78	0.462	0.022	253.07
11	0.30	0.05	7.16	0.462	0.022	226.85
12	0.35	0.05	7.56	0.462	0.022	203.37
13	0.41	0.06	7.98	0.462	0.022	182.32
14	0.48	0.07	8.43	0.462	0.022	163.46
15	0.55	0.08	8.91	0.462	0.022	146.55
16	0.63	0.08	9.40	0.462	0.022	131.40
17	0.71	0.09	9.93	0.462	0.022	117.82
18	0.81	0.10	10.49	0.462	0.022	105.66
19	0.92	0.12	11.08	0.462	0.022	94.75
20	1.05	0.13	11.69	0.462	0.022	84.98
21	1.18	0.14	12.35	0.462	0.022	76.23
22	1.34	0.16	13.04	0.462	0.022	68.38
23	1.51	0.18	13.76	0.462	0.022	61.35
24	1.70	0.20	14.53	0.462	0.022	55.05
25	1.91	0.22	15.34	0.462	0.022	49.40
26	2.14	0.25	16.19	0.462	0.022	44.34
27	2.40	0.28	17.09	0.462	0.022	39.80
28	2.70	0.31	18.03	0.462	0.022	35.74
29	3.02	0.34	19.03	0.462	0.022	32.09
30	3.38	0.38	20.08	0.462	0.022	28.83
31	3.79	0.42	21.18	0.462	0.022	25.90
32	4.24	0.47	22.34	0.462	0.022	23.28
33	4.73	0.53	23.56	0.462	0.022	20.93
34	5.29	0.58	24.85	0.462	0.022	18.83
35	5.91	0.65	26.19	0.462	0.022	16.94
36	6.59	0.72	27.61	0.462	0.022	15.25
37	7.35	0.80	29.09	0.462	0.022	13.74
38	8.20	0.89	30.64	0.462	0.022	12.38
39	9.13	0.99	32.27	0.462	0.022	11.16
40	10.17	1.09	33.97	0.462	0.022	10.07
41	11.32	1.21	35.75	0.462	0.022	9.09
42	12.60	1.34	37.61	0.462	0.022	8.22
43	14.01	1.48	39.54	0.462	0.022	7.43
44	15.56	1.63	41.56	0.462	0.022	6.73
45	17.28	1.80	43.65	0.462	0.022	6.10
46	19.18	1.99	45.83	0.462	0.022	5.53
47	21.27	2.19	48.08	0.462	0.022	5.03
48	23.56	2.40	50.41	0.462	0.022	4.57

49	26.09	2.64	52.81	0.462	0.022	4.17
50	28.85	2.89	55.28	0.462	0.022	3.80
51	31.88	3.16	57.82	0.462	0.022	3.48
52	35.19	3.45	60.42	0.462	0.022	3.18
53	38.80	3.76	63.07	0.462	0.022	2.92
54	42.73	4.09	65.77	0.462	0.022	2.69
55	47.00	4.44	68.51	0.462	0.022	2.48
56	51.62	4.81	71.28	0.462	0.022	2.29
57	56.62	5.19	74.07	0.462	0.022	2.12
58	62.01	5.59	76.87	0.462	0.022	1.97
59	67.81	6.01	79.67	0.462	0.022	1.83
60	74.03	6.43	82.46	0.462	0.022	1.71
61	80.69	6.87	85.22	0.462	0.022	1.60
62	87.78	7.32	87.95	0.462	0.022	1.50
63	95.33	7.77	90.63	0.462	0.022	1.42
64	100.25	2.06	46.60	0.685	0.428	5.35

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.01	2.020	0.091	0.03	0.005	0.450	0.451
2	0.03	2.020	0.096	0.03	0.005	0.450	0.451
3	0.04	2.020	0.101	0.03	0.005	0.450	0.451
4	0.07	2.020	0.107	0.03	0.006	0.450	0.451
5	0.09	2.020	0.113	0.03	0.006	0.450	0.451
6	0.12	2.020	0.119	0.04	0.006	0.450	0.451
7	0.15	2.020	0.126	0.04	0.007	0.450	0.451
8	0.18	2.020	0.133	0.04	0.007	0.450	0.451
9	0.22	2.020	0.140	0.04	0.008	0.450	0.452
10	0.26	2.020	0.148	0.05	0.008	0.450	0.452
11	0.30	2.020	0.156	0.05	0.008	0.450	0.452
12	0.35	2.020	0.165	0.05	0.009	0.450	0.452
13	0.41	2.020	0.175	0.05	0.009	0.450	0.452
14	0.48	2.020	0.184	0.06	0.010	0.450	0.452
15	0.55	2.020	0.195	0.06	0.011	0.450	0.452
16	0.63	2.020	0.206	0.06	0.011	0.450	0.452
17	0.71	2.020	0.217	0.07	0.012	0.450	0.452
18	0.81	2.020	0.229	0.07	0.013	0.450	0.453
19	0.92	2.020	0.242	0.07	0.013	0.450	0.453
20	1.05	2.020	0.256	0.08	0.014	0.450	0.453
21	1.18	2.020	0.270	0.08	0.015	0.450	0.453
22	1.34	2.020	0.285	0.09	0.016	0.450	0.453
23	1.51	2.020	0.301	0.09	0.017	0.450	0.453
24	1.70	2.020	0.318	0.10	0.018	0.450	0.454
25	1.91	2.020	0.335	0.10	0.019	0.450	0.454
26	2.14	2.020	0.354	0.11	0.020	0.450	0.454
27	2.40	2.020	0.374	0.12	0.021	0.450	0.454
28	2.70	2.020	0.394	0.12	0.022	0.450	0.455
29	3.02	2.020	0.416	0.13	0.024	0.450	0.455
30	3.38	2.020	0.439	0.14	0.025	0.450	0.455
31	3.79	2.020	0.463	0.14	0.026	0.450	0.455
32	4.24	2.020	0.488	0.15	0.028	0.450	0.456
33	4.73	2.020	0.515	0.16	0.030	0.450	0.456

34	5.29	2.020	0.543	0.17	0.032	0.450	0.456
35	5.91	2.020	0.573	0.18	0.033	0.450	0.457
36	6.59	2.020	0.603	0.19	0.035	0.450	0.457
37	7.35	2.020	0.636	0.20	0.038	0.450	0.458
38	8.20	2.020	0.670	0.21	0.040	0.450	0.458
39	9.13	2.020	0.705	0.22	0.042	0.450	0.459
40	10.17	2.020	0.743	0.23	0.045	0.450	0.459
41	11.32	2.020	0.781	0.24	0.048	0.450	0.460
42	12.60	2.020	0.822	0.25	0.050	0.450	0.460
43	14.01	2.020	0.864	0.27	0.053	0.450	0.461
44	15.56	2.020	0.908	0.28	0.057	0.450	0.462
45	17.28	2.020	0.954	0.29	0.060	0.450	0.463
46	19.18	2.020	1.002	0.31	0.064	0.450	0.463
47	21.27	2.020	1.051	0.32	0.068	0.450	0.464
48	23.56	2.020	1.102	0.34	0.072	0.450	0.465
49	26.09	2.020	1.154	0.36	0.076	0.450	0.466
50	28.85	2.020	1.208	0.37	0.080	0.450	0.467
51	31.88	2.020	1.264	0.39	0.085	0.450	0.468
52	35.19	2.020	1.321	0.41	0.090	0.450	0.469
53	38.80	2.020	1.379	0.43	0.095	0.450	0.470
54	42.73	2.020	1.438	0.44	0.101	0.450	0.471
55	47.00	2.020	1.498	0.46	0.106	0.450	0.473
56	51.62	2.020	1.558	0.48	0.112	0.450	0.474
57	56.62	2.020	1.619	0.50	0.118	0.450	0.475
58	62.01	2.020	1.680	0.52	0.125	0.450	0.477
59	67.81	2.020	1.741	0.54	0.131	0.450	0.478
60	74.03	2.020	1.802	0.56	0.138	0.450	0.480
61	80.69	2.020	1.863	0.58	0.145	0.450	0.481
62	87.78	2.020	1.922	0.59	0.152	0.450	0.483
63	95.33	2.020	1.981	0.61	0.159	0.450	0.485
64	100.25	2.020	19.926	13.46	-0.543	0.450	0.362

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.02	0.01	1.000	0.998	0.998	0.002
2	0.03	0.03	0.995	0.996	0.996	0.004
3	0.05	0.04	0.998	0.994	0.994	0.006
4	0.08	0.07	0.986	0.991	0.991	0.009
5	0.10	0.09	0.998	0.988	0.988	0.012
6	0.13	0.12	0.975	0.985	0.985	0.015
7	0.16	0.15	0.997	0.981	0.981	0.019
8	0.20	0.18	0.965	0.978	0.977	0.023
9	0.24	0.22	0.989	0.973	0.973	0.027
10	0.28	0.26	0.959	0.968	0.968	0.032
11	0.33	0.30	0.975	0.962	0.963	0.037
12	0.38	0.35	0.954	0.957	0.957	0.043
13	0.44	0.41	0.958	0.950	0.950	0.050
14	0.51	0.48	0.946	0.942	0.942	0.058
15	0.58	0.55	0.941	0.934	0.934	0.066
16	0.67	0.63	0.932	0.925	0.925	0.075
17	0.76	0.71	0.923	0.915	0.915	0.085
18	0.87	0.81	0.914	0.904	0.904	0.096

19	0.98	0.92	0.903	0.892	0.892	0.108
20	1.11	1.05	0.891	0.879	0.879	0.121
21	1.26	1.18	0.879	0.864	0.864	0.136
22	1.42	1.34	0.865	0.848	0.848	0.152
23	1.60	1.51	0.850	0.831	0.831	0.169
24	1.80	1.70	0.834	0.812	0.812	0.188
25	2.02	1.91	0.816	0.791	0.791	0.209
26	2.27	2.14	0.797	0.769	0.769	0.231
27	2.54	2.40	0.777	0.744	0.745	0.255
28	2.85	2.70	0.755	0.719	0.719	0.281
29	3.19	3.02	0.731	0.691	0.692	0.308
30	3.57	3.38	0.707	0.661	0.662	0.338
31	4.00	3.79	0.680	0.630	0.631	0.369
32	4.47	4.24	0.653	0.597	0.598	0.402
33	5.00	4.73	0.624	0.562	0.564	0.436
34	5.58	5.29	0.593	0.526	0.528	0.472
35	6.23	5.91	0.562	0.489	0.491	0.509
36	6.95	6.59	0.530	0.451	0.453	0.547
37	7.75	7.35	0.497	0.412	0.414	0.586
38	8.64	8.20	0.463	0.373	0.375	0.625
39	9.63	9.13	0.429	0.335	0.337	0.663
40	10.72	10.17	0.395	0.297	0.299	0.701
41	11.93	11.32	0.362	0.260	0.262	0.738
42	13.27	12.60	0.329	0.225	0.227	0.773
43	14.75	14.01	0.297	0.192	0.194	0.806
44	16.38	15.56	0.266	0.161	0.163	0.837
45	18.19	17.28	0.237	0.133	0.135	0.865
46	20.17	19.18	0.209	0.108	0.110	0.890
47	22.36	21.27	0.184	0.086	0.088	0.912
48	24.77	23.56	0.160	0.067	0.069	0.931
49	27.41	26.09	0.139	0.052	0.053	0.947
50	30.30	28.85	0.120	0.039	0.040	0.960
51	33.46	31.88	0.103	0.028	0.030	0.970
52	36.92	35.19	0.088	0.020	0.022	0.978
53	40.68	38.80	0.075	0.014	0.016	0.984
54	44.78	42.73	0.064	0.010	0.011	0.989
55	49.22	47.00	0.055	0.006	0.008	0.992
56	54.03	51.62	0.047	0.004	0.005	0.995
57	59.22	56.62	0.040	0.003	0.004	0.996
58	64.81	62.01	0.034	0.002	0.002	0.998
59	70.82	67.81	0.029	0.001	0.002	0.998
60	77.25	74.03	0.025	0.001	0.001	0.999
61	84.12	80.69	0.022	0.000	0.001	0.999
62	91.44	87.78	0.019	0.000	0.001	0.999
63	99.22	95.33	0.017	0.000	0.001	0.999
64	101.27	100.25	0.015	-0.008	0.002	0.998

APPENDIX C-3

COMPUTER OUTPUT BASED ON NEW MODEL (KOBAYASHI)

U0= 5.00 CM/S K= 0.600 1/SEC KLmf/Uo= 8.040

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.32	0.64	18.62	0.427	0.045	17.32
2	1.00	0.73	19.96	0.427	0.045	15.06
3	1.78	0.84	21.39	0.427	0.045	13.12
4	2.68	0.96	22.89	0.427	0.045	11.45
5	3.71	1.10	24.48	0.427	0.045	10.02
6	4.89	1.25	26.15	0.427	0.045	8.78
7	6.23	1.43	27.90	0.427	0.045	7.71
8	7.75	1.62	29.73	0.427	0.045	6.79
9	9.48	1.83	31.62	0.427	0.045	6.00
10	11.43	2.07	33.59	0.427	0.045	5.32
11	13.62	2.32	35.60	0.427	0.045	4.74
12	16.08	2.60	37.67	0.427	0.045	4.23
13	18.83	2.90	39.76	0.427	0.045	3.80
14	21.89	3.21	41.88	0.427	0.045	3.42
15	25.27	3.55	44.00	0.427	0.045	3.10
16	28.99	3.90	46.11	0.427	0.045	2.82
17	33.06	4.26	48.19	0.427	0.045	2.58
18	37.50	4.62	50.23	0.427	0.045	2.38
19	42.31	4.99	52.21	0.427	0.045	2.20
20	47.49	5.37	54.12	0.427	0.045	2.05
21	53.04	5.73	55.94	0.427	0.045	1.92
22	58.96	6.09	57.66	0.427	0.045	1.81
23	65.22	6.44	59.26	0.427	0.045	1.71
24	69.32	1.75	30.92	0.723	0.538	6.28

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.32	2.900	0.847	0.27	0.062	0.400	0.410
2	1.00	2.900	0.908	0.29	0.068	0.400	0.411
3	1.78	2.900	0.973	0.31	0.074	0.400	0.412
4	2.68	2.900	1.041	0.33	0.080	0.400	0.413
5	3.71	2.900	1.114	0.36	0.087	0.400	0.414
6	4.89	2.900	1.190	0.38	0.095	0.400	0.416
7	6.23	2.900	1.269	0.40	0.104	0.400	0.417
8	7.75	2.900	1.352	0.43	0.113	0.400	0.419
9	9.48	2.900	1.439	0.46	0.123	0.400	0.421
10	11.43	2.900	1.528	0.49	0.134	0.400	0.423
11	13.62	2.900	1.619	0.52	0.146	0.400	0.425
12	16.08	2.900	1.713	0.55	0.159	0.400	0.427
13	18.83	2.900	1.809	0.58	0.172	0.400	0.430
14	21.89	2.900	1.905	0.61	0.187	0.400	0.432
15	25.27	2.900	2.001	0.64	0.203	0.400	0.435
16	28.99	2.900	2.097	0.67	0.220	0.400	0.439
17	33.06	2.900	2.192	0.70	0.238	0.400	0.442

18	37.50	2.900	2.285	0.73	0.256	0.400	0.446
19	42.31	2.900	2.375	0.76	0.275	0.400	0.450
20	47.49	2.900	2.462	0.78	0.295	0.400	0.454
21	53.04	2.900	2.544	0.81	0.315	0.400	0.458
22	58.96	2.900	2.623	0.84	0.336	0.400	0.462
23	65.22	2.900	2.697	0.86	0.356	0.400	0.466
24	69.32	2.900	16.636	16.60	-0.659	0.400	0.317

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.64	0.32	1.000	0.956	0.958	0.042
2	1.37	1.00	0.972	0.910	0.913	0.087
3	2.20	1.78	0.935	0.860	0.863	0.137
4	3.16	2.68	0.894	0.806	0.810	0.190
5	4.26	3.71	0.848	0.749	0.753	0.247
6	5.52	4.89	0.801	0.689	0.694	0.306
7	6.94	6.23	0.750	0.627	0.633	0.367
8	8.56	7.75	0.698	0.564	0.570	0.430
9	10.39	9.48	0.645	0.500	0.507	0.493
10	12.46	11.43	0.592	0.438	0.445	0.555
11	14.78	13.62	0.538	0.377	0.384	0.616
12	17.38	16.08	0.485	0.320	0.327	0.673
13	20.28	18.83	0.434	0.267	0.274	0.726
14	23.49	21.89	0.385	0.218	0.226	0.774
15	27.04	25.27	0.339	0.176	0.183	0.817
16	30.94	28.99	0.296	0.139	0.146	0.854
17	35.19	33.06	0.257	0.108	0.114	0.886
18	39.82	37.50	0.221	0.082	0.088	0.912
19	44.81	42.31	0.190	0.061	0.067	0.933
20	50.18	47.49	0.162	0.045	0.051	0.949
21	55.91	53.04	0.137	0.033	0.038	0.962
22	62.00	58.96	0.116	0.024	0.028	0.972
23	68.44	65.22	0.098	0.017	0.020	0.980
24	70.19	69.32	0.088	-0.052	0.023	0.977

U0= 10.00 CM/S K= 0.600 1/SEC KLmf/Uo= 4.020

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.49	0.99	23.19	0.462	0.104	11.16
2	1.59	1.21	25.72	0.462	0.104	9.07
3	2.94	1.49	28.48	0.462	0.104	7.40
4	4.59	1.81	31.46	0.462	0.104	6.07
5	6.60	2.20	34.66	0.462	0.104	5.00
6	9.03	2.65	38.07	0.462	0.104	4.14
7	11.94	3.18	41.65	0.462	0.104	3.46
8	15.42	3.77	45.38	0.462	0.104	2.91

9	19.52	4.44	49.21	0.462	0.104	2.48
10	24.33	5.16	53.09	0.462	0.104	2.13
11	29.88	5.94	56.95	0.462	0.104	1.85
12	36.23	6.75	60.72	0.462	0.104	1.63
13	43.40	7.58	64.34	0.462	0.104	1.45
14	51.39	8.41	67.75	0.462	0.104	1.31
15	60.20	9.21	70.90	0.462	0.104	1.19
16	69.80	9.97	73.77	0.625	0.374	1.10
17	74.79	0.01	2.04	0.802	0.670	1437.48

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.49	7.900	2.415	0.84	0.099	0.400	0.416
2	1.59	7.900	2.679	0.93	0.114	0.400	0.419
3	2.94	7.900	2.966	1.03	0.131	0.400	0.422
4	4.59	7.900	3.277	1.14	0.151	0.400	0.426
5	6.60	7.900	3.610	1.25	0.176	0.400	0.430
6	9.03	7.900	3.964	1.38	0.204	0.400	0.436
7	11.94	7.900	4.338	1.51	0.238	0.400	0.442
8	15.42	7.900	4.726	1.64	0.279	0.400	0.450
9	19.52	7.900	5.125	1.78	0.327	0.400	0.460
10	24.33	7.900	5.529	1.92	0.384	0.400	0.473
11	29.88	7.900	5.931	2.06	0.453	0.400	0.489
12	36.23	7.900	6.323	2.19	0.535	0.400	0.509
13	43.40	7.900	6.701	2.32	0.631	0.400	0.535
14	51.39	7.900	7.056	2.45	0.745	0.400	0.570
15	60.20	7.900	7.384	2.56	0.878	0.400	0.616
16	69.80	7.900	27.614	16.14	-0.573	0.400	0.325
17	74.79	7.900	1.370	3.19	0.122	0.400	0.421

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	0.99	0.49	1.000	0.966	0.969	0.031
2	2.20	1.59	0.982	0.927	0.933	0.067
3	3.68	2.94	0.956	0.883	0.891	0.109
4	5.50	4.59	0.925	0.832	0.842	0.158
5	7.70	6.60	0.889	0.775	0.787	0.213
6	10.35	9.03	0.849	0.712	0.726	0.274
7	13.53	11.94	0.806	0.643	0.660	0.340
8	17.31	15.42	0.759	0.571	0.591	0.409
9	21.74	19.52	0.709	0.497	0.519	0.481
10	26.91	24.33	0.658	0.424	0.449	0.551
11	32.85	29.88	0.606	0.355	0.381	0.619
12	39.60	36.23	0.554	0.290	0.318	0.682
13	47.19	43.40	0.503	0.233	0.261	0.739
14	55.60	51.39	0.454	0.183	0.211	0.789
15	64.81	60.20	0.408	0.141	0.169	0.831
16	74.78	69.80	0.365	0.038	0.161	0.839
17	74.79	74.79	0.341	-0.206	0.161	0.839

U0= 15.00 CM/S K= 0.600 1/SEC KLmf/Uo= 2.680

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.61	1.23	25.91	0.498	0.163	8.94
2	2.02	1.58	29.39	0.498	0.163	6.95
3	3.82	2.02	33.23	0.498	0.163	5.44
4	6.12	2.57	37.44	0.498	0.163	4.28
5	9.02	3.23	41.99	0.498	0.163	3.41
6	12.64	4.02	46.83	0.498	0.163	2.74
7	17.12	4.94	51.90	0.498	0.163	2.23
8	22.57	5.97	57.09	0.498	0.163	1.84
9	29.11	7.11	62.29	0.498	0.163	1.55
10	36.83	8.31	67.36	0.498	0.163	1.32
11	45.76	9.54	72.17	0.498	0.163	1.15
12	55.91	10.76	76.62	0.498	0.163	1.02
13	67.24	11.91	80.61	0.507	0.178	0.92
14	76.63	6.87	61.25	0.760	0.600	1.60

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.61	12.900	4.228	1.61	0.125	0.400	0.421
2	2.02	12.900	4.795	1.83	0.150	0.400	0.425
3	3.82	12.900	5.422	2.06	0.180	0.400	0.431
4	6.12	12.900	6.109	2.33	0.219	0.400	0.438
5	9.02	12.900	6.851	2.61	0.268	0.400	0.448
6	12.64	12.900	7.642	2.91	0.331	0.400	0.461
7	17.12	12.900	8.469	3.22	0.413	0.400	0.479
8	22.57	12.900	9.316	3.55	0.522	0.400	0.506
9	29.11	12.900	10.164	3.87	0.670	0.400	0.546
10	36.83	12.900	10.991	4.19	0.874	0.400	0.615
11	45.76	12.900	11.777	4.48	1.164	0.400	0.749
12	55.91	12.900	12.502	4.76	1.595	0.400	1.105
13	67.24	12.900	14.366	5.61	7.270	0.400	-0.210
14	76.63	12.900	36.721	49.93	-0.921	0.400	0.292

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	1.23	0.61	1.000	0.971	0.976	0.024
2	2.81	2.02	0.986	0.938	0.946	0.054
3	4.84	3.82	0.966	0.899	0.910	0.090
4	7.40	6.12	0.941	0.851	0.866	0.134
5	10.63	9.02	0.911	0.795	0.814	0.186
6	14.65	12.64	0.877	0.731	0.755	0.245
7	19.59	17.12	0.839	0.661	0.690	0.310
8	25.56	22.57	0.797	0.585	0.620	0.380
9	32.67	29.11	0.752	0.507	0.547	0.453
10	40.98	36.83	0.705	0.430	0.475	0.525
11	50.53	45.76	0.657	0.358	0.407	0.593

12	61.28	55.91	0.609	0.292	0.344	0.656
13	73.19	67.24	0.561	0.231	0.289	0.711
14	80.06	76.63	0.525	-0.054	0.293	0.707

U0= 20.00 CM/S k= 0.600 1/SEC KLmf/Uo= 2.010

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.72	1.43	27.95	0.538	0.230	7.68
2	2.38	1.91	32.26	0.538	0.230	5.77
3	4.60	2.52	37.08	0.538	0.230	4.37
4	7.50	3.29	42.40	0.538	0.230	3.34
5	11.28	4.25	48.16	0.538	0.230	2.59
6	16.10	5.40	54.27	0.538	0.230	2.04
7	22.16	6.73	60.59	0.538	0.230	1.64
8	29.63	8.21	66.92	0.538	0.230	1.34
9	38.62	9.78	73.07	0.538	0.230	1.12
10	49.20	11.38	78.82	0.538	0.230	0.97
11	61.36	12.93	84.01	0.538	0.230	0.85
12	75.01	14.36	88.53	0.690	0.484	0.77
13	84.61	4.85	51.43	0.808	0.680	2.27

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.72	17.900	6.434	2.75	0.156	0.400	0.427
2	2.38	17.900	7.426	3.18	0.195	0.400	0.434
3	4.60	17.900	8.535	3.65	0.245	0.400	0.444
4	7.50	17.900	9.759	4.18	0.314	0.400	0.457
5	11.28	17.900	11.086	4.75	0.410	0.400	0.478
6	16.10	17.900	12.493	5.35	0.548	0.400	0.512
7	22.16	17.900	13.947	5.97	0.759	0.400	0.575
8	29.63	17.900	15.405	6.60	1.105	0.400	0.717
9	38.62	17.900	16.819	7.20	1.743	0.400	1.320
10	49.20	17.900	18.143	7.77	3.219	0.400	-1.390
11	61.36	17.900	19.337	8.28	9.618	0.400	-0.140
12	75.01	17.900	42.832	34.63	-0.783	0.400	0.305
13	84.61	17.900	34.993	90.90	-1.938	0.400	0.225

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	1.43	0.72	1.000	0.975	0.981	0.019
2	3.34	2.38	0.988	0.946	0.956	0.044
3	5.86	4.60	0.972	0.910	0.924	0.076
4	9.15	7.50	0.950	0.865	0.884	0.116
5	13.40	11.28	0.925	0.810	0.837	0.163
6	18.80	16.10	0.895	0.747	0.781	0.219
7	25.52	22.16	0.861	0.675	0.718	0.282
8	33.73	29.63	0.824	0.598	0.650	0.350

9	43.51	38.62	0.783	0.519	0.580	0.420
10	54.90	49.20	0.740	0.441	0.510	0.490
11	67.83	61.36	0.696	0.369	0.444	0.556
12	82.19	75.01	0.650	0.199	0.417	0.583
13	87.03	84.61	0.613	0.001	0.417	0.583

APPENDIX C-4

COMPUTER OUTPUT BASED ON NEW MODEL (GRACE)

U0= 10.00 CM/S K= 0.100 1/SEC KLmf/Uo= 1.300

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.08	2.16	20.46	0.012	0.012	5.10
2	3.29	2.27	21.24	0.012	0.012	4.84
3	5.63	2.40	22.04	0.012	0.012	4.59
4	8.09	2.53	22.87	0.012	0.012	4.35
5	10.69	2.67	23.74	0.011	0.011	4.12
6	13.43	2.81	24.63	0.011	0.011	3.91
7	16.32	2.96	25.56	0.011	0.011	3.71
8	19.37	3.13	26.53	0.011	0.011	3.52
9	22.58	3.30	27.53	0.011	0.011	3.34
10	25.96	3.48	28.58	0.011	0.011	3.16
11	29.53	3.67	29.66	0.011	0.011	3.00
12	33.30	3.86	30.78	0.011	0.011	2.85
13	37.27	4.08	31.94	0.011	0.011	2.70
14	41.46	4.30	33.15	0.011	0.011	2.56
15	45.87	4.53	34.40	0.011	0.011	2.43
16	50.52	4.78	35.70	0.011	0.011	2.30
17	55.43	5.04	37.05	0.010	0.010	2.18
18	60.61	5.31	38.45	0.010	0.010	2.07
19	66.06	5.60	39.91	0.010	0.010	1.96
20	71.82	5.91	41.41	0.010	0.010	1.86
21	77.89	6.23	42.98	0.010	0.010	1.77
22	84.28	6.57	44.60	0.010	0.010	1.68
23	91.03	6.92	46.29	0.010	0.010	1.59
24	98.14	7.30	48.04	0.010	0.010	1.51
25	105.64	7.70	49.86	0.010	0.010	1.43
26	113.55	8.12	51.74	0.010	0.010	1.35
27	121.89	8.56	53.70	0.010	0.010	1.29
28	130.68	9.03	55.73	0.010	0.010	1.22
29	139.07	7.75	50.08	0.010	0.010	1.42

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.08	4.700	0.242	0.07	0.007	0.400	0.401
2	3.29	4.700	0.249	0.08	0.008	0.400	0.401
3	5.63	4.700	0.257	0.08	0.008	0.400	0.401
4	8.09	4.700	0.264	0.08	0.008	0.400	0.401
5	10.69	4.700	0.272	0.08	0.008	0.400	0.401
6	13.43	4.700	0.280	0.09	0.009	0.400	0.401
7	16.32	4.700	0.289	0.09	0.009	0.400	0.401
8	19.37	4.700	0.297	0.09	0.009	0.400	0.401
9	22.58	4.700	0.306	0.09	0.010	0.400	0.402
10	25.96	4.700	0.315	0.10	0.010	0.400	0.402
11	29.53	4.700	0.324	0.10	0.010	0.400	0.402
12	33.30	4.700	0.334	0.10	0.010	0.400	0.402

13	37.27	4.700	0.344	0.10	0.011	0.400	0.402
14	41.46	4.700	0.354	0.11	0.011	0.400	0.402
15	45.87	4.700	0.364	0.11	0.011	0.400	0.402
16	50.52	4.700	0.375	0.11	0.012	0.400	0.402
17	55.43	4.700	0.386	0.12	0.012	0.400	0.402
18	60.61	4.700	0.398	0.12	0.012	0.400	0.402
19	66.06	4.700	0.410	0.12	0.013	0.400	0.402
20	71.82	4.700	0.422	0.13	0.013	0.400	0.402
21	77.89	4.700	0.434	0.13	0.014	0.400	0.402
22	84.28	4.700	0.447	0.14	0.014	0.400	0.402
23	91.03	4.700	0.460	0.14	0.015	0.400	0.402
24	98.14	4.700	0.474	0.14	0.015	0.400	0.402
25	105.64	4.700	0.488	0.15	0.015	0.400	0.402
26	113.55	4.700	0.502	0.15	0.016	0.400	0.403
27	121.89	4.700	0.517	0.16	0.016	0.400	0.403
28	130.68	4.700	0.532	0.16	0.017	0.400	0.403
29	139.07	4.700	0.490	0.15	0.015	0.400	0.402

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.16	1.08	1.000	0.979	0.979	0.021
2	4.43	3.29	0.988	0.957	0.958	0.042
3	6.83	5.63	0.972	0.935	0.935	0.065
4	9.36	8.09	0.953	0.912	0.913	0.087
5	12.03	10.69	0.933	0.889	0.889	0.111
6	14.84	13.43	0.912	0.865	0.865	0.135
7	17.80	16.32	0.890	0.840	0.841	0.159
8	20.93	19.37	0.868	0.815	0.815	0.185
9	24.23	22.58	0.845	0.789	0.790	0.210
10	27.70	25.96	0.822	0.763	0.763	0.237
11	31.37	29.53	0.799	0.736	0.737	0.263
12	35.23	33.30	0.775	0.709	0.710	0.290
13	39.31	37.27	0.751	0.681	0.682	0.318
14	43.60	41.46	0.726	0.654	0.654	0.346
15	48.14	45.87	0.701	0.626	0.626	0.374
16	52.91	50.52	0.676	0.597	0.598	0.402
17	57.95	55.43	0.651	0.569	0.570	0.430
18	63.26	60.61	0.626	0.540	0.541	0.459
19	68.86	66.06	0.601	0.512	0.513	0.487
20	74.77	71.82	0.576	0.484	0.485	0.515
21	81.00	77.89	0.551	0.456	0.457	0.543
22	87.57	84.28	0.526	0.428	0.429	0.571
23	94.49	91.03	0.501	0.400	0.401	0.599
24	101.79	98.14	0.476	0.373	0.374	0.626
25	109.49	105.64	0.452	0.347	0.348	0.652
26	117.61	113.55	0.428	0.321	0.322	0.678
27	126.17	121.89	0.405	0.296	0.297	0.703

28	135.20	130.68	0.382	0.272	0.273	0.727
29	142.94	139.07	0.362	0.252	0.253	0.747

U0= 15.00 CM/S K= 0.100 1/SEC KLmf/Uo= 0.867

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.09	2.19	20.66	0.016	0.016	5.03
2	3.37	2.37	21.84	0.016	0.016	4.65
3	5.84	2.56	23.09	0.015	0.015	4.29
4	8.51	2.78	24.41	0.015	0.015	3.96
5	11.40	3.01	25.81	0.015	0.015	3.66
6	14.53	3.26	27.29	0.015	0.015	3.38
7	17.92	3.52	28.85	0.015	0.015	3.12
8	21.59	3.82	30.51	0.015	0.015	2.88
9	25.56	4.13	32.25	0.014	0.014	2.66
10	29.87	4.47	34.10	0.014	0.014	2.46
11	34.53	4.84	36.05	0.014	0.014	2.27
12	39.57	5.25	38.12	0.014	0.014	2.10
13	45.04	5.68	40.30	0.014	0.014	1.94
14	50.95	6.15	42.61	0.014	0.014	1.79
15	57.36	6.66	45.04	0.013	0.013	1.65
16	64.29	7.21	47.62	0.013	0.013	1.53
17	71.80	7.81	50.35	0.013	0.013	1.41
18	79.93	8.45	53.23	0.013	0.013	1.30
19	88.74	9.15	56.28	0.013	0.013	1.20
20	98.27	9.91	59.50	0.013	0.013	1.11
21	108.59	10.73	62.91	0.012	0.012	1.02
22	119.77	11.62	66.51	0.012	0.012	0.95
23	131.87	12.58	70.32	0.012	0.012	0.87
24	144.98	13.63	74.35	0.012	0.012	0.81
25	153.33	3.09	26.29	0.015	0.015	3.56

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.09	9.700	0.326	0.10	0.007	0.400	0.401
2	3.37	9.700	0.341	0.10	0.007	0.400	0.401
3	5.84	9.700	0.356	0.11	0.007	0.400	0.401
4	8.51	9.700	0.372	0.11	0.008	0.400	0.401
5	11.40	9.700	0.389	0.12	0.008	0.400	0.401
6	14.53	9.700	0.406	0.12	0.008	0.400	0.401
7	17.92	9.700	0.424	0.13	0.009	0.400	0.401
8	21.59	9.700	0.443	0.14	0.009	0.400	0.401
9	25.56	9.700	0.463	0.14	0.010	0.400	0.402
10	29.87	9.700	0.484	0.15	0.010	0.400	0.402
11	34.53	9.700	0.505	0.15	0.011	0.400	0.402
12	39.57	9.700	0.528	0.16	0.011	0.400	0.402

13	45.04	9.700	0.551	0.17	0.011	0.400	0.402
14	50.95	9.700	0.576	0.18	0.012	0.400	0.402
15	57.36	9.700	0.602	0.18	0.013	0.400	0.402
16	64.29	9.700	0.629	0.19	0.013	0.400	0.402
17	71.80	9.700	0.657	0.20	0.014	0.400	0.402
18	79.93	9.700	0.686	0.21	0.014	0.400	0.402
19	88.74	9.700	0.717	0.22	0.015	0.400	0.402
20	98.27	9.700	0.749	0.23	0.016	0.400	0.403
21	108.59	9.700	0.782	0.24	0.017	0.400	0.403
22	119.77	9.700	0.817	0.25	0.017	0.400	0.403
23	131.87	9.700	0.854	0.26	0.018	0.400	0.403
24	144.98	9.700	0.892	0.27	0.019	0.400	0.403
25	153.33	9.700	0.394	0.12	0.008	0.400	0.401

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.19	1.09	1.000	0.986	0.986	0.014
2	4.55	3.37	0.992	0.970	0.971	0.029
3	7.12	5.84	0.981	0.954	0.955	0.045
4	9.90	8.51	0.968	0.937	0.938	0.062
5	12.90	11.40	0.953	0.919	0.919	0.081
6	16.16	14.53	0.938	0.900	0.900	0.100
7	19.68	17.92	0.922	0.879	0.880	0.120
8	23.50	21.59	0.905	0.858	0.858	0.142
9	27.63	25.56	0.887	0.835	0.836	0.164
10	32.10	29.87	0.869	0.811	0.812	0.188
11	36.95	34.53	0.849	0.786	0.787	0.213
12	42.19	39.57	0.829	0.760	0.761	0.239
13	47.88	45.04	0.808	0.732	0.733	0.267
14	54.03	50.95	0.787	0.704	0.705	0.295
15	60.69	57.36	0.764	0.674	0.675	0.325
16	67.90	64.29	0.741	0.643	0.645	0.355
17	75.70	71.80	0.718	0.612	0.613	0.387
18	84.16	79.93	0.694	0.580	0.581	0.419
19	93.31	88.74	0.669	0.547	0.548	0.452
20	103.23	98.27	0.644	0.513	0.515	0.485
21	113.96	108.59	0.619	0.479	0.481	0.519
22	125.58	119.77	0.594	0.445	0.447	0.553
23	138.17	131.87	0.568	0.411	0.413	0.587
24	151.79	144.98	0.542	0.377	0.379	0.621
25	154.88	153.33	0.527	0.369	0.371	0.629

U0= 21.40 CM/S K= 0.100 1/SEC KLmf/Uo= 0.607

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.11	2.23	20.92	0.019	0.019	4.94

2	3.47	2.49	22.65	0.019	0.019	4.41
3	6.12	2.79	24.52	0.019	0.019	3.94
4	9.08	3.13	26.55	0.018	0.018	3.51
5	12.40	3.51	28.75	0.018	0.018	3.14
6	16.11	3.93	31.13	0.018	0.018	2.80
7	20.28	4.40	33.70	0.017	0.017	2.50
8	24.94	4.93	36.49	0.017	0.017	2.23
9	30.17	5.52	39.51	0.017	0.017	1.99
10	36.02	6.19	42.77	0.017	0.017	1.78
11	42.58	6.93	46.31	0.016	0.016	1.59
12	49.92	7.76	50.14	0.016	0.016	1.42
13	58.15	8.70	54.29	0.016	0.016	1.27
14	67.37	9.74	58.78	0.015	0.015	1.13
15	77.70	10.91	63.65	0.015	0.015	1.01
16	89.27	12.22	68.91	0.015	0.015	0.90
17	102.23	13.69	74.61	0.015	0.015	0.80
18	116.74	15.34	80.78	0.014	0.014	0.72
19	133.01	17.19	87.47	0.014	0.014	0.64
20	151.23	19.25	94.70	0.014	0.014	0.57
21	166.20	10.70	62.78	0.015	0.015	1.03

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.11	16.100	0.403	0.12	0.006	0.400	0.401
2	3.47	16.100	0.429	0.13	0.006	0.400	0.401
3	6.12	16.100	0.457	0.14	0.007	0.400	0.401
4	9.08	16.100	0.487	0.15	0.007	0.400	0.401
5	12.40	16.100	0.518	0.16	0.007	0.400	0.401
6	16.11	16.100	0.551	0.17	0.008	0.400	0.401
7	20.28	16.100	0.587	0.18	0.009	0.400	0.401
8	24.94	16.100	0.625	0.19	0.009	0.400	0.401
9	30.17	16.100	0.665	0.20	0.010	0.400	0.402
10	36.02	16.100	0.708	0.22	0.010	0.400	0.402
11	42.58	16.100	0.753	0.23	0.011	0.400	0.402
12	49.92	16.100	0.802	0.25	0.012	0.400	0.402
13	58.15	16.100	0.854	0.26	0.013	0.400	0.402
14	67.37	16.100	0.909	0.28	0.013	0.400	0.402
15	77.70	16.100	0.967	0.30	0.014	0.400	0.402
16	89.27	16.100	1.029	0.31	0.015	0.400	0.402
17	102.23	16.100	1.096	0.34	0.016	0.400	0.403
18	116.74	16.100	1.166	0.36	0.017	0.400	0.403
19	133.01	16.100	1.241	0.38	0.019	0.400	0.403
20	151.23	16.100	1.321	0.40	0.020	0.400	0.403
21	166.20	16.100	0.957	0.29	0.014	0.400	0.402

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.23	1.11	1.000	0.990	0.990	0.010

2	4.72	3.47	0.994	0.978	0.979	0.021
3	7.51	6.12	0.986	0.966	0.966	0.034
4	10.64	9.08	0.977	0.952	0.953	0.047
5	14.15	12.40	0.966	0.937	0.938	0.062
6	18.08	16.11	0.954	0.920	0.921	0.079
7	22.48	20.28	0.942	0.902	0.903	0.097
8	27.41	24.94	0.928	0.882	0.883	0.117
9	32.93	30.17	0.913	0.860	0.861	0.139
10	39.11	36.02	0.898	0.836	0.837	0.163
11	46.04	42.58	0.881	0.810	0.811	0.189
12	53.80	49.92	0.863	0.782	0.783	0.217
13	62.50	58.15	0.844	0.752	0.753	0.247
14	72.24	67.37	0.824	0.720	0.721	0.279
15	83.15	77.70	0.804	0.685	0.687	0.313
16	95.38	89.27	0.782	0.648	0.650	0.350
17	109.07	102.23	0.759	0.610	0.612	0.388
18	124.41	116.74	0.736	0.569	0.572	0.428
19	141.60	133.01	0.712	0.527	0.530	0.470
20	160.85	151.23	0.687	0.484	0.487	0.513
21	171.55	166.20	0.669	0.461	0.464	0.536

U0= 10.00 CM/S K= 0.150 1/SEC KLmf/Uo= 1.950

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.08	2.16	20.46	0.012	0.012	5.10
2	3.29	2.27	21.24	0.012	0.012	4.84
3	5.63	2.40	22.04	0.012	0.012	4.59
4	8.09	2.53	22.87	0.012	0.012	4.35
5	10.69	2.67	23.74	0.011	0.011	4.12
6	13.43	2.81	24.63	0.011	0.011	3.91
7	16.32	2.96	25.56	0.011	0.011	3.71
8	19.37	3.13	26.53	0.011	0.011	3.52
9	22.58	3.30	27.53	0.011	0.011	3.34
10	25.96	3.48	28.58	0.011	0.011	3.16
11	29.53	3.67	29.66	0.011	0.011	3.00
12	33.30	3.86	30.78	0.011	0.011	2.85
13	37.27	4.08	31.94	0.011	0.011	2.70
14	41.46	4.30	33.15	0.011	0.011	2.56
15	45.87	4.53	34.40	0.011	0.011	2.43
16	50.52	4.78	35.70	0.011	0.011	2.30
17	55.43	5.04	37.05	0.010	0.010	2.18
18	60.61	5.31	38.45	0.010	0.010	2.07
19	66.06	5.60	39.91	0.010	0.010	1.96
20	71.82	5.91	41.41	0.010	0.010	1.86
21	77.89	6.23	42.98	0.010	0.010	1.77

22	84.28	6.57	44.60	0.010	0.010	1.68
23	91.03	6.92	46.29	0.010	0.010	1.59
24	98.14	7.30	48.04	0.010	0.010	1.51
25	105.64	7.70	49.86	0.010	0.010	1.43
26	113.55	8.12	51.74	0.010	0.010	1.35
27	121.89	8.56	53.70	0.010	0.010	1.29
28	130.68	9.03	55.73	0.010	0.010	1.22
29	139.07	7.75	50.08	0.010	0.010	1.42

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.08	4.700	0.242	0.07	0.007	0.400	0.401
2	3.29	4.700	0.249	0.08	0.008	0.400	0.401
3	5.63	4.700	0.257	0.08	0.008	0.400	0.401
4	8.09	4.700	0.264	0.08	0.008	0.400	0.401
5	10.69	4.700	0.272	0.08	0.008	0.400	0.401
6	13.43	4.700	0.280	0.09	0.009	0.400	0.401
7	16.32	4.700	0.289	0.09	0.009	0.400	0.401
8	19.37	4.700	0.297	0.09	0.009	0.400	0.401
9	22.58	4.700	0.306	0.09	0.010	0.400	0.402
10	25.96	4.700	0.315	0.10	0.010	0.400	0.402
11	29.53	4.700	0.324	0.10	0.010	0.400	0.402
12	33.30	4.700	0.334	0.10	0.010	0.400	0.402
13	37.27	4.700	0.344	0.10	0.011	0.400	0.402
14	41.46	4.700	0.354	0.11	0.011	0.400	0.402
15	45.87	4.700	0.364	0.11	0.011	0.400	0.402
16	50.52	4.700	0.375	0.11	0.012	0.400	0.402
17	55.43	4.700	0.386	0.12	0.012	0.400	0.402
18	60.61	4.700	0.398	0.12	0.012	0.400	0.402
19	66.06	4.700	0.410	0.12	0.013	0.400	0.402
20	71.82	4.700	0.422	0.13	0.013	0.400	0.402
21	77.89	4.700	0.434	0.13	0.014	0.400	0.402
22	84.28	4.700	0.447	0.14	0.014	0.400	0.402
23	91.03	4.700	0.460	0.14	0.015	0.400	0.402
24	98.14	4.700	0.474	0.14	0.015	0.400	0.402
25	105.64	4.700	0.488	0.15	0.015	0.400	0.402
26	113.55	4.700	0.502	0.15	0.016	0.400	0.403
27	121.89	4.700	0.517	0.16	0.016	0.400	0.403
28	130.68	4.700	0.532	0.16	0.017	0.400	0.403
29	139.07	4.700	0.490	0.15	0.015	0.400	0.402

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.16	1.08	1.000	0.969	0.969	0.031
2	4.43	3.29	0.983	0.937	0.937	0.063
3	6.83	5.63	0.958	0.905	0.905	0.095
4	9.36	8.09	0.931	0.872	0.873	0.127
5	12.03	10.69	0.902	0.839	0.839	0.161

6	14.84	13.43	0.872	0.805	0.806	0.194
7	17.80	16.32	0.841	0.771	0.772	0.228
8	20.93	19.37	0.810	0.737	0.738	0.262
9	24.23	22.58	0.779	0.703	0.703	0.297
10	27.70	25.96	0.748	0.668	0.669	0.331
11	31.37	29.53	0.716	0.634	0.635	0.365
12	35.23	33.30	0.685	0.599	0.600	0.400
13	39.31	37.27	0.653	0.565	0.566	0.434
14	43.60	41.46	0.622	0.531	0.532	0.468
15	48.14	45.87	0.591	0.498	0.499	0.501
16	52.91	50.52	0.560	0.465	0.466	0.534
17	57.95	55.43	0.530	0.432	0.433	0.567
18	63.26	60.61	0.500	0.401	0.402	0.598
19	68.86	66.06	0.471	0.370	0.371	0.629
20	74.77	71.82	0.442	0.340	0.341	0.659
21	81.00	77.89	0.415	0.311	0.312	0.688
22	87.57	84.28	0.387	0.284	0.285	0.715
23	94.49	91.03	0.361	0.257	0.258	0.742
24	101.79	98.14	0.336	0.232	0.233	0.767
25	109.49	105.64	0.311	0.208	0.209	0.791
26	117.61	113.55	0.288	0.186	0.187	0.813
27	126.17	121.89	0.266	0.165	0.166	0.834
28	135.20	130.68	0.244	0.145	0.146	0.854
29	142.94	139.07	0.226	0.130	0.131	0.869

U0= 15.00 CM/S K= 0.150 1/SEC KLmf/Uo= 1.300

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.09	2.19	20.66	0.016	0.016	5.03
2	3.37	2.37	21.84	0.016	0.016	4.65
3	5.84	2.56	23.09	0.015	0.015	4.29
4	8.51	2.78	24.41	0.015	0.015	3.96
5	11.40	3.01	25.81	0.015	0.015	3.66
6	14.53	3.26	27.29	0.015	0.015	3.38
7	17.92	3.52	28.85	0.015	0.015	3.12
8	21.59	3.82	30.51	0.015	0.015	2.88
9	25.56	4.13	32.25	0.014	0.014	2.66
10	29.87	4.47	34.10	0.014	0.014	2.46
11	34.53	4.84	36.05	0.014	0.014	2.27
12	39.57	5.25	38.12	0.014	0.014	2.10
13	45.04	5.68	40.30	0.014	0.014	1.94
14	50.95	6.15	42.61	0.014	0.014	1.79
15	57.36	6.66	45.04	0.013	0.013	1.65
16	64.29	7.21	47.62	0.013	0.013	1.53
17	71.80	7.81	50.35	0.013	0.013	1.41

18	79.93	8.45	53.23	0.013	0.013	1.30
19	88.74	9.15	56.28	0.013	0.013	1.20
20	98.27	9.91	59.50	0.013	0.013	1.11
21	108.59	10.73	62.91	0.012	0.012	1.02
22	119.77	11.62	66.51	0.012	0.012	0.95
23	131.87	12.58	70.32	0.012	0.012	0.87
24	144.98	13.63	74.35	0.012	0.012	0.81
25	153.33	3.09	26.29	0.015	0.015	3.56

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	1.09	9.700	0.326	0.10	0.007	0.400	0.401
2	3.37	9.700	0.341	0.10	0.007	0.400	0.401
3	5.84	9.700	0.356	0.11	0.007	0.400	0.401
4	8.51	9.700	0.372	0.11	0.008	0.400	0.401
5	11.40	9.700	0.389	0.12	0.008	0.400	0.401
6	14.53	9.700	0.406	0.12	0.008	0.400	0.401
7	17.92	9.700	0.424	0.13	0.009	0.400	0.401
8	21.59	9.700	0.443	0.14	0.009	0.400	0.401
9	25.56	9.700	0.463	0.14	0.010	0.400	0.402
10	29.87	9.700	0.484	0.15	0.010	0.400	0.402
11	34.53	9.700	0.505	0.15	0.011	0.400	0.402
12	39.57	9.700	0.528	0.16	0.011	0.400	0.402
13	45.04	9.700	0.551	0.17	0.011	0.400	0.402
14	50.95	9.700	0.576	0.18	0.012	0.400	0.402
15	57.36	9.700	0.602	0.18	0.013	0.400	0.402
16	64.29	9.700	0.629	0.19	0.013	0.400	0.402
17	71.80	9.700	0.657	0.20	0.014	0.400	0.402
18	79.93	9.700	0.686	0.21	0.014	0.400	0.402
19	88.74	9.700	0.717	0.22	0.015	0.400	0.402
20	98.27	9.700	0.749	0.23	0.016	0.400	0.403
21	108.59	9.700	0.782	0.24	0.017	0.400	0.403
22	119.77	9.700	0.817	0.25	0.017	0.400	0.403
23	131.87	9.700	0.854	0.26	0.018	0.400	0.403
24	144.98	9.700	0.892	0.27	0.019	0.400	0.403
25	153.33	9.700	0.394	0.12	0.008	0.400	0.401

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.19	1.09	1.000	0.979	0.979	0.021
2	4.55	3.37	0.988	0.956	0.957	0.043
3	7.12	5.84	0.971	0.933	0.933	0.067
4	9.90	8.51	0.952	0.908	0.908	0.092
5	12.90	11.40	0.931	0.881	0.882	0.118
6	16.16	14.53	0.909	0.854	0.855	0.145
7	19.68	17.92	0.886	0.825	0.826	0.174
8	23.50	21.59	0.862	0.795	0.796	0.204
9	27.63	25.56	0.837	0.764	0.765	0.235

10	32.10	29.87	0.811	0.732	0.733	0.267
11	36.95	34.53	0.784	0.698	0.699	0.301
12	42.19	39.57	0.757	0.664	0.665	0.335
13	47.88	45.04	0.729	0.629	0.630	0.370
14	54.03	50.95	0.700	0.593	0.594	0.406
15	60.69	57.36	0.671	0.556	0.557	0.443
16	67.90	64.29	0.642	0.519	0.521	0.479
17	75.70	71.80	0.612	0.482	0.483	0.517
18	84.16	79.93	0.583	0.445	0.446	0.554
19	93.31	88.74	0.553	0.408	0.409	0.591
20	103.23	98.27	0.523	0.371	0.373	0.627
21	113.96	108.59	0.494	0.336	0.338	0.662
22	125.58	119.77	0.465	0.301	0.303	0.697
23	138.17	131.87	0.437	0.268	0.270	0.730
24	151.79	144.98	0.409	0.236	0.238	0.762
25	154.88	153.33	0.394	0.229	0.231	0.769

U0= 21.40 CM/S K= 0.150 1/SEC KLmf/Uo= 0.911

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.11	2.23	20.92	0.019	0.019	4.94
2	3.47	2.49	22.65	0.019	0.019	4.41
3	6.12	2.79	24.52	0.019	0.019	3.94
4	9.08	3.13	26.55	0.018	0.018	3.51
5	12.40	3.51	28.75	0.018	0.018	3.14
6	16.11	3.93	31.13	0.018	0.018	2.80
7	20.28	4.40	33.70	0.017	0.017	2.50
8	24.94	4.93	36.49	0.017	0.017	2.23
9	30.17	5.52	39.51	0.017	0.017	1.99
10	36.02	6.19	42.77	0.017	0.017	1.78
11	42.58	6.93	46.31	0.016	0.016	1.59
12	49.92	7.76	50.14	0.016	0.016	1.42
13	58.15	8.70	54.29	0.016	0.016	1.27
14	67.37	9.74	58.78	0.015	0.015	1.13
15	77.70	10.91	63.65	0.015	0.015	1.01
16	89.27	12.22	68.91	0.015	0.015	0.90
17	102.23	13.69	74.61	0.015	0.015	0.80
18	116.74	15.34	80.78	0.014	0.014	0.72
19	133.01	17.19	87.47	0.014	0.014	0.64
20	151.23	19.25	94.70	0.014	0.014	0.57
21	166.20	10.70	62.78	0.015	0.015	1.03

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.11	16.100	0.403	0.12	0.006	0.400	0.401
2	3.47	16.100	0.429	0.13	0.006	0.400	0.401

3	6.12	16.100	0.457	0.14	0.007	0.400	0.401
4	9.08	16.100	0.487	0.15	0.007	0.400	0.401
5	12.40	16.100	0.518	0.16	0.007	0.400	0.401
6	16.11	16.100	0.551	0.17	0.008	0.400	0.401
7	20.28	16.100	0.587	0.18	0.009	0.400	0.401
8	24.94	16.100	0.625	0.19	0.009	0.400	0.401
9	30.17	16.100	0.665	0.20	0.010	0.400	0.402
10	36.02	16.100	0.708	0.22	0.010	0.400	0.402
11	42.58	16.100	0.753	0.23	0.011	0.400	0.402
12	49.92	16.100	0.802	0.25	0.012	0.400	0.402
13	58.15	16.100	0.854	0.26	0.013	0.400	0.402
14	67.37	16.100	0.909	0.28	0.013	0.400	0.402
15	77.70	16.100	0.967	0.30	0.014	0.400	0.402
16	89.27	16.100	1.029	0.31	0.015	0.400	0.402
17	102.23	16.100	1.096	0.34	0.016	0.400	0.403
18	116.74	16.100	1.166	0.36	0.017	0.400	0.403
19	133.01	16.100	1.241	0.38	0.019	0.400	0.403
20	151.23	16.100	1.321	0.40	0.020	0.400	0.403
21	166.20	16.100	0.957	0.29	0.014	0.400	0.402

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.23	1.11	1.000	0.985	0.985	0.015
2	4.72	3.47	0.991	0.968	0.968	0.032
3	7.51	6.12	0.979	0.950	0.950	0.050
4	10.64	9.08	0.965	0.929	0.930	0.070
5	14.15	12.40	0.949	0.907	0.908	0.092
6	18.08	16.11	0.932	0.883	0.884	0.116
7	22.48	20.28	0.914	0.857	0.858	0.142
8	27.41	24.94	0.894	0.829	0.830	0.170
9	32.93	30.17	0.874	0.799	0.800	0.200
10	39.11	36.02	0.851	0.766	0.767	0.233
11	46.04	42.58	0.828	0.731	0.732	0.268
12	53.80	49.92	0.803	0.693	0.695	0.305
13	62.50	58.15	0.778	0.654	0.656	0.344
14	72.24	67.37	0.751	0.613	0.615	0.385
15	83.15	77.70	0.724	0.569	0.572	0.428
16	95.38	89.27	0.695	0.525	0.527	0.473
17	109.07	102.23	0.667	0.479	0.482	0.518
18	124.41	116.74	0.637	0.433	0.436	0.564
19	141.60	133.01	0.608	0.387	0.390	0.610
20	160.85	151.23	0.578	0.342	0.345	0.655
21	171.55	166.20	0.557	0.318	0.321	0.679

U0= 10.00 CM/S K= 0.200 1/SEC KLmf/Uo= 2.600

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.08	2.16	20.46	0.012	0.012	5.10
2	3.29	2.27	21.24	0.012	0.012	4.84
3	5.63	2.40	22.04	0.012	0.012	4.59
4	8.09	2.53	22.87	0.012	0.012	4.35
5	10.69	2.67	23.74	0.011	0.011	4.12
6	13.43	2.81	24.63	0.011	0.011	3.91
7	16.32	2.96	25.56	0.011	0.011	3.71
8	19.37	3.13	26.53	0.011	0.011	3.52
9	22.58	3.30	27.53	0.011	0.011	3.34
10	25.96	3.48	28.58	0.011	0.011	3.16
11	29.53	3.67	29.66	0.011	0.011	3.00
12	33.30	3.86	30.78	0.011	0.011	2.85
13	37.27	4.08	31.94	0.011	0.011	2.70
14	41.46	4.30	33.15	0.011	0.011	2.56
15	45.87	4.53	34.40	0.011	0.011	2.43
16	50.52	4.78	35.70	0.011	0.011	2.30
17	55.43	5.04	37.05	0.010	0.010	2.18
18	60.61	5.31	38.45	0.010	0.010	2.07
19	66.06	5.60	39.91	0.010	0.010	1.96
20	71.82	5.91	41.41	0.010	0.010	1.86
21	77.89	6.23	42.98	0.010	0.010	1.77
22	84.28	6.57	44.60	0.010	0.010	1.68
23	91.03	6.92	46.29	0.010	0.010	1.59
24	98.14	7.30	48.04	0.010	0.010	1.51
25	105.64	7.70	49.86	0.010	0.010	1.43
26	113.55	8.12	51.74	0.010	0.010	1.35
27	121.89	8.56	53.70	0.010	0.010	1.29
28	130.68	9.03	55.73	0.010	0.010	1.22
29	139.07	7.75	50.08	0.010	0.010	1.42

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.08	4.700	0.242	0.07	0.007	0.400	0.401
2	3.29	4.700	0.249	0.08	0.008	0.400	0.401
3	5.63	4.700	0.257	0.08	0.008	0.400	0.401
4	8.09	4.700	0.264	0.08	0.008	0.400	0.401
5	10.69	4.700	0.272	0.08	0.008	0.400	0.401
6	13.43	4.700	0.280	0.09	0.009	0.400	0.401
7	16.32	4.700	0.289	0.09	0.009	0.400	0.401
8	19.37	4.700	0.297	0.09	0.009	0.400	0.401
9	22.58	4.700	0.306	0.09	0.010	0.400	0.402
10	25.96	4.700	0.315	0.10	0.010	0.400	0.402
11	29.53	4.700	0.324	0.10	0.010	0.400	0.402
12	33.30	4.700	0.334	0.10	0.010	0.400	0.402

13	37.27	4.700	0.344	0.10	0.011	0.400	0.402
14	41.46	4.700	0.354	0.11	0.011	0.400	0.402
15	45.87	4.700	0.364	0.11	0.011	0.400	0.402
16	50.52	4.700	0.375	0.11	0.012	0.400	0.402
17	55.43	4.700	0.386	0.12	0.012	0.400	0.402
18	60.61	4.700	0.398	0.12	0.012	0.400	0.402
19	66.06	4.700	0.410	0.12	0.013	0.400	0.402
20	71.82	4.700	0.422	0.13	0.013	0.400	0.402
21	77.89	4.700	0.434	0.13	0.014	0.400	0.402
22	84.28	4.700	0.447	0.14	0.014	0.400	0.402
23	91.03	4.700	0.460	0.14	0.015	0.400	0.402
24	98.14	4.700	0.474	0.14	0.015	0.400	0.402
25	105.64	4.700	0.488	0.15	0.015	0.400	0.402
26	113.55	4.700	0.502	0.15	0.016	0.400	0.403
27	121.89	4.700	0.517	0.16	0.016	0.400	0.403
28	130.68	4.700	0.532	0.16	0.017	0.400	0.403
29	139.07	4.700	0.490	0.15	0.015	0.400	0.402

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.16	1.08	1.000	0.959	0.959	0.041
2	4.43	3.29	0.977	0.917	0.918	0.082
3	6.83	5.63	0.945	0.876	0.876	0.124
4	9.36	8.09	0.910	0.834	0.835	0.165
5	12.03	10.69	0.872	0.792	0.793	0.207
6	14.84	13.43	0.834	0.750	0.751	0.249
7	17.80	16.32	0.796	0.709	0.710	0.290
8	20.93	19.37	0.757	0.667	0.668	0.332
9	24.23	22.58	0.719	0.627	0.628	0.372
10	27.70	25.96	0.681	0.586	0.587	0.413
11	31.37	29.53	0.644	0.547	0.548	0.452
12	35.23	33.30	0.607	0.508	0.509	0.491
13	39.31	37.27	0.570	0.470	0.471	0.529
14	43.60	41.46	0.535	0.433	0.434	0.566
15	48.14	45.87	0.500	0.397	0.398	0.602
16	52.91	50.52	0.466	0.363	0.364	0.636
17	57.95	55.43	0.434	0.330	0.331	0.669
18	63.26	60.61	0.402	0.299	0.300	0.700
19	68.86	66.06	0.372	0.269	0.270	0.730
20	74.77	71.82	0.343	0.241	0.242	0.758
21	81.00	77.89	0.315	0.214	0.215	0.785
22	87.57	84.28	0.288	0.190	0.191	0.809
23	94.49	91.03	0.263	0.167	0.168	0.832
24	101.79	98.14	0.240	0.146	0.147	0.853
25	109.49	105.64	0.218	0.127	0.127	0.873
26	117.61	113.55	0.197	0.109	0.110	0.890
27	126.17	121.89	0.178	0.093	0.094	0.906
28	135.20	130.68	0.160	0.079	0.080	0.920
29	142.94	139.07	0.145	0.069	0.069	0.931

U0= 15.00 CM/S K= 0.200 1/SEC KLmf/Uo= 1.733

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.09	2.19	20.66	0.016	0.016	5.03
2	3.37	2.37	21.84	0.016	0.016	4.65
3	5.84	2.56	23.09	0.015	0.015	4.29
4	8.51	2.78	24.41	0.015	0.015	3.96
5	11.40	3.01	25.81	0.015	0.015	3.66
6	14.53	3.26	27.29	0.015	0.015	3.38
7	17.92	3.52	28.85	0.015	0.015	3.12
8	21.59	3.82	30.51	0.015	0.015	2.88
9	25.56	4.13	32.25	0.014	0.014	2.66
10	29.87	4.47	34.10	0.014	0.014	2.46
11	34.53	4.84	36.05	0.014	0.014	2.27
12	39.57	5.25	38.12	0.014	0.014	2.10
13	45.04	5.68	40.30	0.014	0.014	1.94
14	50.95	6.15	42.61	0.014	0.014	1.79
15	57.36	6.66	45.04	0.013	0.013	1.65
16	64.29	7.21	47.62	0.013	0.013	1.53
17	71.80	7.81	50.35	0.013	0.013	1.41
18	79.93	8.45	53.23	0.013	0.013	1.30
19	88.74	9.15	56.28	0.013	0.013	1.20
20	98.27	9.91	59.50	0.013	0.013	1.11
21	108.59	10.73	62.91	0.012	0.012	1.02
22	119.77	11.62	66.51	0.012	0.012	0.95
23	131.87	12.58	70.32	0.012	0.012	0.87
24	144.98	13.63	74.35	0.012	0.012	0.81
25	153.33	3.09	26.29	0.015	0.015	3.56

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.09	9.700	0.326	0.10	0.007	0.400	0.401
2	3.37	9.700	0.341	0.10	0.007	0.400	0.401
3	5.84	9.700	0.356	0.11	0.007	0.400	0.401
4	8.51	9.700	0.372	0.11	0.008	0.400	0.401
5	11.40	9.700	0.389	0.12	0.008	0.400	0.401
6	14.53	9.700	0.406	0.12	0.008	0.400	0.401
7	17.92	9.700	0.424	0.13	0.009	0.400	0.401
8	21.59	9.700	0.443	0.14	0.009	0.400	0.401
9	25.56	9.700	0.463	0.14	0.010	0.400	0.402
10	29.87	9.700	0.484	0.15	0.010	0.400	0.402
11	34.53	9.700	0.505	0.15	0.011	0.400	0.402
12	39.57	9.700	0.528	0.16	0.011	0.400	0.402
13	45.04	9.700	0.551	0.17	0.011	0.400	0.402
14	50.95	9.700	0.576	0.18	0.012	0.400	0.402
15	57.36	9.700	0.602	0.18	0.013	0.400	0.402
16	64.29	9.700	0.629	0.19	0.013	0.400	0.402
17	71.80	9.700	0.657	0.20	0.014	0.400	0.402
18	79.93	9.700	0.686	0.21	0.014	0.400	0.402
19	88.74	9.700	0.717	0.22	0.015	0.400	0.402
20	98.27	9.700	0.749	0.23	0.016	0.400	0.403

21	108.59	9.700	0.782	0.24	0.017	0.400	0.403
22	119.77	9.700	0.817	0.25	0.017	0.400	0.403
23	131.87	9.700	0.854	0.26	0.018	0.400	0.403
24	144.98	9.700	0.892	0.27	0.019	0.400	0.403
25	153.33	9.700	0.394	0.12	0.008	0.400	0.401

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.19	1.09	1.000	0.972	0.972	0.028
2	4.55	3.37	0.984	0.942	0.943	0.057
3	7.12	5.84	0.962	0.911	0.912	0.088
4	9.90	8.51	0.937	0.879	0.880	0.120
5	12.90	11.40	0.910	0.846	0.847	0.153
6	16.16	14.53	0.881	0.811	0.812	0.188
7	19.68	17.92	0.852	0.775	0.776	0.224
8	23.50	21.59	0.821	0.738	0.739	0.261
9	27.63	25.56	0.790	0.700	0.701	0.299
10	32.10	29.87	0.758	0.661	0.662	0.338
11	36.95	34.53	0.725	0.621	0.623	0.377
12	42.19	39.57	0.692	0.581	0.583	0.417
13	47.88	45.04	0.659	0.541	0.542	0.458
14	54.03	50.95	0.625	0.500	0.502	0.498
15	60.69	57.36	0.592	0.460	0.462	0.538
16	67.90	64.29	0.558	0.420	0.422	0.578
17	75.70	71.80	0.525	0.381	0.383	0.617
18	84.16	79.93	0.492	0.343	0.344	0.656
19	93.31	88.74	0.460	0.306	0.308	0.692
20	103.23	98.27	0.428	0.270	0.272	0.728
21	113.96	108.59	0.398	0.237	0.239	0.761
22	125.58	119.77	0.369	0.205	0.207	0.793
23	138.17	131.87	0.341	0.176	0.178	0.822
24	151.79	144.98	0.314	0.149	0.151	0.849
25	154.88	153.33	0.299	0.143	0.146	0.854

U0= 21.40 CM/S K= 0.200 1/SEC KLmf/Uo= 1.215

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.11	2.23	20.92	0.019	0.019	4.94
2	3.47	2.49	22.65	0.019	0.019	4.41
3	6.12	2.79	24.52	0.019	0.019	3.94
4	9.08	3.13	26.55	0.018	0.018	3.51
5	12.40	3.51	28.75	0.018	0.018	3.14
6	16.11	3.93	31.13	0.018	0.018	2.80
7	20.28	4.40	33.70	0.017	0.017	2.50
8	24.94	4.93	36.49	0.017	0.017	2.23
9	30.17	5.52	39.51	0.017	0.017	1.99
10	36.02	6.19	42.77	0.017	0.017	1.78
11	42.58	6.93	46.31	0.016	0.016	1.59
12	49.92	7.76	50.14	0.016	0.016	1.42
13	58.15	8.70	54.29	0.016	0.016	1.27

14	67.37	9.74	58.78	0.015	0.015	1.13
15	77.70	10.91	63.65	0.015	0.015	1.01
16	89.27	12.22	68.91	0.015	0.015	0.90
17	102.23	13.69	74.61	0.015	0.015	0.80
18	116.74	15.34	80.78	0.014	0.014	0.72
19	133.01	17.19	87.47	0.014	0.014	0.64
20	151.23	19.25	94.70	0.014	0.014	0.57
21	166.20	10.70	62.78	0.015	0.015	1.03

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	1.11	16.100	0.403	0.12	0.006	0.400	0.401
2	3.47	16.100	0.429	0.13	0.006	0.400	0.401
3	6.12	16.100	0.457	0.14	0.007	0.400	0.401
4	9.08	16.100	0.487	0.15	0.007	0.400	0.401
5	12.40	16.100	0.518	0.16	0.007	0.400	0.401
6	16.11	16.100	0.551	0.17	0.008	0.400	0.401
7	20.28	16.100	0.587	0.18	0.009	0.400	0.401
8	24.94	16.100	0.625	0.19	0.009	0.400	0.401
9	30.17	16.100	0.665	0.20	0.010	0.400	0.402
10	36.02	16.100	0.708	0.22	0.010	0.400	0.402
11	42.58	16.100	0.753	0.23	0.011	0.400	0.402
12	49.92	16.100	0.802	0.25	0.012	0.400	0.402
13	58.15	16.100	0.854	0.26	0.013	0.400	0.402
14	67.37	16.100	0.909	0.28	0.013	0.400	0.402
15	77.70	16.100	0.967	0.30	0.014	0.400	0.402
16	89.27	16.100	1.029	0.31	0.015	0.400	0.402
17	102.23	16.100	1.096	0.34	0.016	0.400	0.403
18	116.74	16.100	1.166	0.36	0.017	0.400	0.403
19	133.01	16.100	1.241	0.38	0.019	0.400	0.403
20	151.23	16.100	1.321	0.40	0.020	0.400	0.403
21	166.20	16.100	0.957	0.29	0.014	0.400	0.402

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.23	1.11	1.000	0.980	0.980	0.020
2	4.72	3.47	0.989	0.958	0.958	0.042
3	7.51	6.12	0.973	0.933	0.934	0.066
4	10.64	9.08	0.954	0.907	0.908	0.092
5	14.15	12.40	0.933	0.879	0.880	0.120
6	18.08	16.11	0.911	0.848	0.849	0.151
7	22.48	20.28	0.888	0.815	0.816	0.184
8	27.41	24.94	0.863	0.780	0.781	0.219
9	32.93	30.17	0.836	0.742	0.743	0.257
10	39.11	36.02	0.808	0.702	0.704	0.296
11	46.04	42.58	0.779	0.660	0.662	0.338
12	53.80	49.92	0.749	0.615	0.618	0.382
13	62.50	58.15	0.718	0.570	0.572	0.428
14	72.24	67.37	0.686	0.523	0.525	0.475
15	83.15	77.70	0.654	0.475	0.477	0.523
16	95.38	89.27	0.621	0.427	0.429	0.571
17	109.07	102.23	0.588	0.379	0.382	0.618

18	124.41	116.74	0.555	0.332	0.335	0.665
19	141.60	133.01	0.523	0.286	0.290	0.710
20	160.85	151.23	0.491	0.243	0.246	0.754
21	171.55	166.20	0.469	0.221	0.225	0.775

APPENDIX C-5

COMPUTER OUTPUT BASED ON NEW MODEL (MASSIMILLA)

U0= 3.40 CM/S K= 0.045 1/SEC KLmf/Uo= 0.761

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.02	0.04	3.66	0.425	0.042	286.65
2	0.08	0.09	5.52	0.425	0.042	125.56
3	0.23	0.20	8.35	0.425	0.042	55.00
4	0.55	0.46	12.61	0.425	0.042	24.09
5	1.30	1.04	19.06	0.425	0.042	10.55
6	3.02	2.38	28.79	0.425	0.042	4.62
7	6.92	5.43	43.51	0.425	0.042	2.02
8	15.84	12.41	65.74	0.425	0.042	0.89
9	36.21	28.32	99.33	0.425	0.042	0.39
10	55.46	10.18	59.54	1.000	0.042	1.06

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.02	2.960	0.154	0.05	0.014	0.400	0.402
2	0.08	2.960	0.232	0.07	0.022	0.400	0.404
3	0.23	2.960	0.351	0.11	0.035	0.400	0.406
4	0.55	2.960	0.530	0.17	0.056	0.400	0.409
5	1.30	2.960	0.801	0.25	0.094	0.400	0.416
6	3.02	2.960	1.210	0.38	0.168	0.400	0.429
7	6.92	2.960	1.828	0.58	0.354	0.400	0.466
8	15.84	2.960	2.762	0.88	1.316	0.400	0.845
9	36.21	2.960	4.174	1.32	-1.640	0.400	0.242
10	55.46	2.960	2.502	0.79	0.847	0.400	0.605

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	0.04	0.02	1.000	1.000	1.000	0.000
2	0.13	0.08	0.999	0.999	0.999	0.001
3	0.33	0.23	1.000	0.997	0.998	0.002
4	0.78	0.55	0.994	0.994	0.994	0.006
5	1.83	1.30	0.994	0.986	0.986	0.014
6	4.21	3.02	0.986	0.968	0.969	0.031
7	9.64	6.92	0.975	0.929	0.931	0.069
8	22.04	15.84	0.956	0.847	0.852	0.148
9	50.37	36.21	0.926	0.694	0.704	0.296
10	60.54	55.46	0.909	0.643	0.654	0.346

U0= 5.20 CM/S K= 0.045 1/SEC KLmf/Uo= 0.497

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.05	0.11	6.15	0.433	0.055	101.17
2	0.24	0.26	9.60	0.433	0.055	41.59
3	0.69	0.64	14.97	0.433	0.055	17.09
4	1.80	1.57	23.35	0.433	0.055	7.03
5	4.49	3.81	36.43	0.433	0.055	2.89
6	11.02	9.27	56.82	0.433	0.055	1.19
7	26.93	22.54	88.62	0.433	0.055	0.49
8	49.79	23.17	89.84	0.941	0.055	0.47

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.05	4.760	0.338	0.11	0.021	0.400	0.403
2	0.24	4.760	0.528	0.17	0.034	0.400	0.406
3	0.69	4.760	0.823	0.27	0.057	0.400	0.409
4	1.80	4.760	1.284	0.41	0.100	0.400	0.417
5	4.49	4.760	2.002	0.65	0.191	0.400	0.433
6	11.02	4.760	3.123	1.01	0.459	0.400	0.490
7	26.93	4.760	4.871	1.57	4.524	0.400	-0.494
8	49.79	4.760	4.939	1.60	5.769	0.400	-0.306

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.11	0.05	1.000	0.999	0.999	0.001
2	0.37	0.24	0.998	0.998	0.998	0.002
3	1.02	0.69	0.998	0.995	0.995	0.005
4	2.58	1.80	0.994	0.987	0.988	0.012
5	6.39	4.49	0.988	0.969	0.970	0.030
6	15.66	11.02	0.978	0.925	0.928	0.072
7	38.20	26.93	0.960	0.830	0.837	0.163
8	61.37	49.79	0.944	0.742	0.753	0.247

U0= 7.90 CM/S K= 0.045 1/SEC KLmf/Uo= 0.327

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.16	0.31	10.42	0.443	0.071	35.28
2	0.73	0.83	16.99	0.443	0.071	13.28
3	2.24	2.20	27.70	0.443	0.071	5.00
4	6.27	5.85	45.15	0.443	0.071	1.88
5	16.97	15.55	73.60	0.443	0.071	0.71
6	43.59	37.69	114.59	0.443	0.071	0.29

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.16	7.460	0.741	0.24	0.032	0.400	0.405
2	0.73	7.460	1.208	0.40	0.055	0.400	0.409
3	2.24	7.460	1.969	0.65	0.102	0.400	0.417
4	6.27	7.460	3.209	1.06	0.210	0.400	0.437
5	16.97	7.460	5.232	1.73	0.602	0.400	0.527
6	43.59	7.460	8.145	2.69	-10.209	0.400	0.079

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.31	0.16	1.000	0.999	0.999	0.001
2	1.14	0.73	0.998	0.996	0.996	0.004
3	3.34	2.24	0.996	0.989	0.990	0.010
4	9.19	6.27	0.991	0.970	0.972	0.028
5	24.75	16.97	0.982	0.922	0.927	0.073
6	62.44	43.59	0.967	0.819	0.829	0.171

U0= 10.00 CM/S K= 0.045 1/SEC KLmf/Uo= 0.259

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.29	0.59	14.32	0.450	0.083	18.69
2	1.42	1.67	24.10	0.450	0.083	6.60
3	4.62	4.72	40.56	0.450	0.083	2.33
4	13.67	13.38	68.26	0.450	0.083	0.82
5	39.30	37.89	114.88	0.450	0.083	0.29
6	60.73	4.98	41.64	0.674	0.456	2.21

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.29	9.560	1.182	0.40	0.041	0.400	0.407
2	1.42	9.560	1.989	0.67	0.077	0.400	0.413
3	4.62	9.560	3.348	1.13	0.155	0.400	0.426
4	13.67	9.560	5.634	1.89	0.398	0.400	0.476
5	39.30	9.560	9.483	3.19	5.650	0.400	-0.317
6	60.73	9.560	18.997	14.01	-0.847	0.400	0.299

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	0.59	0.29	1.000	0.998	0.999	0.001
2	2.26	1.42	0.998	0.994	0.994	0.006
3	6.98	4.62	0.995	0.982	0.983	0.017
4	20.35	13.67	0.988	0.949	0.952	0.048
5	58.24	39.30	0.976	0.862	0.872	0.128
6	63.22	60.73	0.970	0.779	0.866	0.134

U0= 14.30 CM/S K= 0.045 1/SEC KLmf/Uo= 0.181

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.89	1.78	24.93	0.463	0.106	6.17
2	4.63	5.69	44.53	0.463	0.106	1.93
3	16.56	18.16	79.54	0.463	0.106	0.61
4	45.25	39.22	116.89	0.463	0.106	0.28

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.89	13.860	2.636	0.92	0.070	0.400	0.412
2	4.63	13.860	4.708	1.64	0.153	0.400	0.426
3	16.56	13.860	8.410	2.92	0.444	0.400	0.486
4	45.25	13.860	12.358	4.30	1.980	0.400	1.921

I	HHT	Hn	CB/C0	CE/C0	C/C0	CONV
1	1.78	0.89	1.000	0.997	0.997	0.003
2	7.48	4.63	0.997	0.987	0.988	0.012
3	25.64	16.56	0.992	0.955	0.959	0.041
4	64.86	45.25	0.983	0.890	0.900	0.100

APPENDIX C-6

COMPUTER OUTPUT BASED ON NEW MODEL (LEWIS)

U0= 4.80 CM/S K= 0.930 1/SEC KLmf/Uo= 8.137

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.04	0.09	5.86	0.461	0.101	128.54
2	0.14	0.11	6.57	0.461	0.101	102.29
3	0.26	0.13	7.36	0.461	0.101	81.53
4	0.41	0.17	8.24	0.461	0.101	65.09
5	0.60	0.21	9.21	0.461	0.101	52.08
6	0.84	0.26	10.28	0.461	0.101	41.79
7	1.13	0.33	11.46	0.461	0.101	33.64
8	1.50	0.40	12.75	0.461	0.101	27.19
9	1.95	0.50	14.14	0.461	0.101	22.09
10	2.51	0.61	15.65	0.461	0.101	18.05
11	3.18	0.74	17.25	0.461	0.101	14.85
12	4.00	0.89	18.93	0.461	0.101	12.32
13	4.98	1.07	20.69	0.461	0.101	10.32
14	6.14	1.26	22.49	0.461	0.101	8.74
15	7.50	1.47	24.30	0.461	0.101	7.48
16	9.08	1.69	26.09	0.461	0.101	6.49
17	10.90	1.93	27.82	0.461	0.101	5.71
18	12.94	2.16	29.48	0.461	0.101	5.09
19	15.22	2.39	31.01	0.461	0.101	4.59
20	17.72	2.62	32.42	0.461	0.101	4.20
21	20.44	2.82	33.67	0.461	0.101	3.90
22	23.36	3.01	34.78	0.461	0.101	3.65
23	26.46	3.18	35.74	0.461	0.101	3.46
24	29.71	3.33	36.55	0.461	0.101	3.31
25	33.10	3.45	37.24	0.461	0.101	3.19
26	36.61	3.56	37.81	0.461	0.101	3.09
27	40.21	3.65	38.29	0.461	0.101	3.01
28	43.90	3.72	38.67	0.639	0.398	2.95
29	46.24	0.97	19.69	0.780	0.634	11.39

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	0.04	4.490	0.593	0.20	0.044	0.400	0.407
2	0.14	4.490	0.664	0.23	0.050	0.400	0.408
3	0.26	4.490	0.744	0.26	0.057	0.400	0.409
4	0.41	4.490	0.833	0.29	0.065	0.400	0.411
5	0.60	4.490	0.931	0.32	0.075	0.400	0.412
6	0.84	4.490	1.040	0.36	0.086	0.400	0.414
7	1.13	4.490	1.159	0.40	0.099	0.400	0.416
8	1.50	4.490	1.289	0.45	0.114	0.400	0.419
9	1.95	4.490	1.430	0.49	0.132	0.400	0.422
10	2.51	4.490	1.582	0.55	0.153	0.400	0.426
11	3.18	4.490	1.744	0.60	0.177	0.400	0.430
12	4.00	4.490	1.914	0.66	0.206	0.400	0.436
13	4.98	4.490	2.092	0.72	0.240	0.400	0.442
14	6.14	4.490	2.273	0.79	0.279	0.400	0.450
15	7.50	4.490	2.456	0.85	0.325	0.400	0.460
16	9.08	4.490	2.637	0.91	0.379	0.400	0.471

17	10.90	4.490	2.813	0.97	0.439	0.400	0.485
18	12.94	4.490	2.980	1.03	0.508	0.400	0.502
19	15.22	4.490	3.135	1.08	0.585	0.400	0.522
20	17.72	4.490	3.277	1.13	0.668	0.400	0.546
21	20.44	4.490	3.404	1.18	0.757	0.400	0.574
22	23.36	4.490	3.516	1.21	0.850	0.400	0.606
23	26.46	4.490	3.613	1.25	0.945	0.400	0.643
24	29.71	4.490	3.695	1.28	1.039	0.400	0.684
25	33.10	4.490	3.765	1.30	1.129	0.400	0.729
26	36.61	4.490	3.823	1.32	1.214	0.400	0.778
27	40.21	4.490	3.871	1.34	1.293	0.400	0.828
28	43.90	4.490	15.405	9.58	-0.544	0.400	0.329
29	46.24	4.490	12.479	21.25	-1.014	0.400	0.285

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.09	0.04	1.000	0.990	0.991	0.009
2	0.19	0.14	0.979	0.980	0.980	0.020
3	0.33	0.26	0.981	0.965	0.967	0.033
4	0.50	0.41	0.954	0.949	0.950	0.050
5	0.71	0.60	0.947	0.927	0.929	0.071
6	0.97	0.84	0.921	0.903	0.904	0.096
7	1.30	1.13	0.899	0.872	0.875	0.125
8	1.70	1.50	0.870	0.836	0.839	0.161
9	2.20	1.95	0.837	0.794	0.798	0.202
10	2.81	2.51	0.800	0.745	0.751	0.249
11	3.55	3.18	0.757	0.690	0.697	0.303
12	4.44	4.00	0.710	0.630	0.638	0.362
13	5.51	4.98	0.659	0.566	0.575	0.425
14	6.77	6.14	0.605	0.499	0.510	0.490
15	8.24	7.50	0.549	0.432	0.443	0.557
16	9.93	9.08	0.492	0.366	0.379	0.621
17	11.86	10.90	0.435	0.304	0.317	0.683
18	14.02	12.94	0.380	0.248	0.261	0.739
19	16.42	15.22	0.328	0.199	0.212	0.788
20	19.03	17.72	0.280	0.156	0.169	0.831
21	21.86	20.44	0.236	0.121	0.133	0.867
22	24.87	23.36	0.198	0.093	0.104	0.896
23	28.05	26.46	0.164	0.071	0.080	0.920
24	31.37	29.71	0.134	0.053	0.062	0.938
25	34.83	33.10	0.110	0.040	0.047	0.953
26	38.39	36.61	0.089	0.030	0.036	0.964
27	42.03	40.21	0.071	0.022	0.027	0.973
28	45.76	43.90	0.057	0.005	0.026	0.974
29	46.72	46.24	0.048	-0.011	0.026	0.974

U0= 9.30 CM/S K= 0.930 1/SEC KLmf/Uo= 4.200

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.18	0.36	11.95	0.508	0.180	30.95

2	0.59	0.47	13.78	0.508	0.180	23.25
3	1.14	0.62	15.84	0.508	0.180	17.61
4	1.86	0.82	18.11	0.508	0.180	13.47
5	2.80	1.05	20.58	0.508	0.180	10.43
6	4.00	1.34	23.21	0.508	0.180	8.20
7	5.50	1.68	25.94	0.508	0.180	6.57
8	7.37	2.05	28.69	0.508	0.180	5.37
9	9.62	2.45	31.38	0.508	0.180	4.49
10	12.27	2.86	33.91	0.508	0.180	3.84
11	15.33	3.26	36.21	0.508	0.180	3.37
12	18.79	3.64	38.23	0.508	0.180	3.02
13	22.59	3.97	39.95	0.508	0.180	2.77
14	26.71	4.26	41.37	0.508	0.180	2.58
15	31.09	4.50	42.52	0.508	0.180	2.44
16	35.69	4.69	43.42	0.508	0.180	2.34
17	40.46	4.85	44.12	0.508	0.180	2.27
18	45.36	4.97	44.66	0.658	0.430	2.22
19	49.54	3.40	36.94	0.783	0.638	3.24

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.18	8.990	2.155	0.84	0.097	0.400	0.416
2	0.59	8.990	2.486	0.97	0.117	0.400	0.420
3	1.14	8.990	2.857	1.12	0.142	0.400	0.424
4	1.86	8.990	3.267	1.28	0.174	0.400	0.430
5	2.80	8.990	3.713	1.45	0.213	0.400	0.437
6	4.00	8.990	4.187	1.64	0.263	0.400	0.447
7	5.50	8.990	4.679	1.83	0.325	0.400	0.460
8	7.37	8.990	5.175	2.03	0.403	0.400	0.477
9	9.62	8.990	5.659	2.22	0.499	0.400	0.500
10	12.27	8.990	6.116	2.40	0.617	0.400	0.531
11	15.33	8.990	6.531	2.56	0.758	0.400	0.574
12	18.79	8.990	6.896	2.70	0.921	0.400	0.633
13	22.59	8.990	7.206	2.82	1.105	0.400	0.717
14	26.71	8.990	7.462	2.92	1.304	0.400	0.836
15	31.09	8.990	7.669	3.01	1.510	0.400	1.010
16	35.69	8.990	7.832	3.07	1.714	0.400	1.272
17	40.46	8.990	7.959	3.12	1.906	0.400	1.684
18	45.36	8.990	19.220	13.09	-0.752	0.400	0.308
19	49.54	8.990	23.555	41.31	-1.050	0.400	0.282

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	0.36	0.18	1.000	0.979	0.983	0.017
2	0.83	0.59	0.978	0.957	0.961	0.039
3	1.45	1.14	0.958	0.926	0.932	0.068
4	2.27	1.86	0.933	0.888	0.896	0.104
5	3.32	2.80	0.902	0.842	0.853	0.147
6	4.67	4.00	0.866	0.787	0.801	0.199
7	6.34	5.50	0.824	0.723	0.741	0.259
8	8.39	7.37	0.776	0.653	0.675	0.325
9	10.84	9.62	0.725	0.580	0.606	0.394

10	13.70	12.27	0.669	0.505	0.535	0.465
11	16.97	15.33	0.612	0.433	0.465	0.535
12	20.61	18.79	0.555	0.366	0.400	0.600
13	24.58	22.59	0.498	0.305	0.340	0.660
14	28.84	26.71	0.443	0.253	0.287	0.713
15	33.34	31.09	0.391	0.208	0.241	0.759
16	38.03	35.69	0.343	0.171	0.202	0.798
17	42.88	40.46	0.298	0.140	0.168	0.832
18	47.85	45.36	0.258	0.077	0.155	0.845
19	51.24	49.54	0.221	0.033	0.153	0.847

U0= 15.30 CM/S K= 0.930 1/SEC KLmf/Uo= 2.553

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.51	1.01	20.15	0.574	0.289	10.88
2	1.70	1.38	23.56	0.574	0.289	7.96
3	3.31	1.84	27.20	0.574	0.289	5.97
4	5.43	2.39	30.96	0.574	0.289	4.61
5	8.11	2.99	34.64	0.574	0.289	3.68
6	11.41	3.61	38.07	0.574	0.289	3.05
7	15.32	4.20	41.09	0.574	0.289	2.62
8	19.79	4.74	43.63	0.574	0.289	2.32
9	24.75	5.19	45.66	0.574	0.289	2.12
10	30.12	5.55	47.22	0.574	0.289	1.98
11	35.81	5.83	48.38	0.574	0.289	1.89
12	41.74	6.03	49.23	0.574	0.289	1.82
13	47.85	6.18	49.84	0.697	0.495	1.78
14	54.09	6.29	50.27	0.790	0.649	1.75
15	58.17	1.87	27.41	0.834	0.724	5.88

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.51	14.990	5.831	2.80	0.210	0.400	0.437
2	1.70	14.990	6.816	3.28	0.275	0.400	0.449
3	3.31	14.990	7.871	3.79	0.362	0.400	0.468
4	5.43	14.990	8.957	4.31	0.483	0.400	0.496
5	8.11	14.990	10.023	4.82	0.649	0.400	0.540
6	11.41	14.990	11.015	5.30	0.878	0.400	0.617
7	15.32	14.990	11.890	5.72	1.192	0.400	0.764
8	19.79	14.990	12.624	6.07	1.612	0.400	1.126
9	24.75	14.990	13.211	6.35	2.161	0.400	2.950
10	30.12	14.990	13.663	6.57	2.852	0.400	-2.843
11	35.81	14.990	14.000	6.73	3.680	0.400	-0.848
12	41.74	14.990	14.246	6.85	4.617	0.400	-0.472
13	47.85	14.990	24.680	20.78	-1.119	0.400	0.276
14	54.09	14.990	32.647	62.91	-1.271	0.400	0.265
15	58.17	14.990	19.842	100.96	-6.137	0.400	0.116

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	1.01	0.51	1.000	0.964	0.975	0.025

2	2.39	1.70	0.977	0.927	0.942	0.058
3	4.23	3.31	0.950	0.879	0.900	0.100
4	6.62	5.43	0.917	0.821	0.849	0.151
5	9.61	8.11	0.879	0.754	0.790	0.210
6	13.21	11.41	0.835	0.682	0.727	0.273
7	17.42	15.32	0.787	0.609	0.660	0.340
8	22.16	19.79	0.736	0.537	0.594	0.406
9	27.34	24.75	0.684	0.469	0.531	0.469
10	32.90	30.12	0.630	0.408	0.473	0.527
11	38.72	35.81	0.577	0.355	0.419	0.581
12	44.76	41.74	0.526	0.308	0.371	0.629
13	50.94	47.85	0.476	0.218	0.346	0.654
14	57.23	54.09	0.419	0.172	0.332	0.668
15	59.10	58.17	0.384	0.184	0.329	0.671

U0= 19.30 CM/S K= 0.930 1/SEC KLmf/Uo= 2.024

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	0.82	1.63	25.59	0.623	0.371	6.75
2	2.74	2.22	29.85	0.623	0.371	4.96
3	5.30	2.91	34.18	0.623	0.371	3.78
4	8.58	3.65	38.31	0.623	0.371	3.01
5	12.61	4.39	42.01	0.623	0.371	2.50
6	17.34	5.07	45.12	0.623	0.371	2.17
7	22.69	5.63	47.58	0.623	0.371	1.95
8	28.55	6.08	49.43	0.623	0.371	1.81
9	34.80	6.42	50.78	0.623	0.371	1.71
10	41.34	6.66	51.72	0.623	0.371	1.65
11	48.08	6.83	52.38	0.705	0.508	1.61
12	54.97	6.95	52.83	0.776	0.627	1.58
13	61.96	7.03	53.13	0.831	0.719	1.57
14	66.12	1.30	22.84	0.857	0.762	8.47

I	Hn	UO-UMF	Q	Us	B	EMF	CAL EMF
1	0.82	18.990	9.493	5.50	0.353	0.400	0.466
2	2.74	18.990	11.076	6.42	0.491	0.400	0.498
3	5.30	18.990	12.681	7.35	0.698	0.400	0.555
4	8.58	18.990	14.214	8.24	1.019	0.400	0.675
5	12.61	18.990	15.587	9.03	1.530	0.400	1.031
6	17.34	18.990	16.738	9.70	2.382	0.400	8.454
7	22.69	18.990	17.651	10.23	3.901	0.400	-0.714
8	28.55	18.990	18.339	10.63	6.953	0.400	-0.225
9	34.80	18.990	18.838	10.92	14.859	0.400	-0.081
10	41.34	18.990	19.190	11.12	63.573	0.400	-0.016
11	48.08	18.990	26.608	23.50	-1.582	0.400	0.245
12	54.97	18.990	33.145	53.94	-1.452	0.400	0.253
13	61.96	18.990	38.198	175.46	-2.609	0.400	0.196
14	66.12	18.990	17.418	593.45	74.900	0.400	-0.014

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	1.63	0.82	1.000	0.955	0.972	0.028
2	3.85	2.74	0.977	0.910	0.935	0.065
3	6.76	5.30	0.949	0.855	0.890	0.110
4	10.41	8.58	0.915	0.791	0.837	0.163
5	14.81	12.61	0.876	0.723	0.779	0.221
6	19.87	17.34	0.833	0.652	0.719	0.281
7	25.51	22.69	0.786	0.585	0.659	0.341
8	31.59	28.55	0.738	0.521	0.602	0.398
9	38.01	34.80	0.688	0.464	0.547	0.453
10	44.67	41.34	0.639	0.414	0.497	0.503
11	51.50	48.08	0.590	0.335	0.465	0.535
12	58.45	54.97	0.536	0.287	0.443	0.557
13	65.47	61.96	0.484	0.282	0.427	0.573
14	66.77	66.12	0.459	0.313	0.424	0.576

U0= 26.00 CM/S K= 0.930 1/SEC KLmf/Uo= 1.502

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	1.48	2.96	34.50	0.720	0.533	3.71
2	4.91	3.90	39.58	0.720	0.533	2.82
3	9.29	4.85	44.14	0.720	0.533	2.27
4	14.57	5.72	47.93	0.720	0.533	1.92
5	20.65	6.43	50.83	0.720	0.533	1.71
6	27.35	6.97	52.93	0.720	0.533	1.58
7	34.52	7.36	54.38	0.720	0.533	1.49
8	42.01	7.62	55.34	0.720	0.533	1.44
9	49.73	7.80	55.97	0.762	0.603	1.41
10	57.58	7.91	56.38	0.798	0.663	1.39
11	65.53	7.99	56.63	0.828	0.714	1.38
12	73.54	8.03	56.80	0.855	0.758	1.37
13	81.58	8.06	56.90	0.877	0.795	1.36
14	87.79	4.36	41.84	0.892	0.820	2.52

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	1.48	25.690	18.393	17.98	1.103	0.400	0.716
2	4.91	25.690	21.101	20.63	1.966	0.400	1.872
3	9.29	25.690	23.537	23.01	4.362	0.400	-0.537
4	14.57	25.690	25.554	24.98	26.150	0.400	-0.042
5	20.65	25.690	27.103	26.50	-11.213	0.400	0.073
6	27.35	25.690	28.222	27.59	-5.797	0.400	0.121
7	34.52	25.690	28.993	28.35	-4.421	0.400	0.144
8	42.01	25.690	29.515	28.87	-3.833	0.400	0.158
9	49.73	25.690	33.730	46.72	-2.402	0.400	0.204
10	57.58	25.690	37.358	80.88	-2.402	0.400	0.204
11	65.53	25.690	40.446	169.48	-3.354	0.400	0.171
12	73.54	25.690	43.059	893.16	-12.665	0.400	0.066
13	81.58	25.690	45.262	-398.28	4.229	0.400	-0.578
14	87.79	25.690	34.320	-155.12	3.351	0.400	-1.176

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	2.96	1.48	1.000	0.940	0.972	0.028
2	6.86	4.91	0.978	0.891	0.937	0.063
3	11.71	9.29	0.951	0.835	0.897	0.103
4	17.43	14.57	0.919	0.776	0.852	0.148
5	23.86	20.65	0.884	0.717	0.806	0.194
6	30.84	27.35	0.847	0.661	0.760	0.240
7	38.20	34.52	0.807	0.610	0.715	0.285
8	45.83	42.01	0.766	0.564	0.672	0.328
9	53.62	49.73	0.726	0.506	0.638	0.362
10	61.54	57.58	0.682	0.472	0.611	0.389
11	69.52	65.53	0.641	0.458	0.589	0.411
12	77.55	73.54	0.605	0.458	0.570	0.430
13	85.61	81.58	0.577	0.462	0.553	0.447
14	89.97	87.79	0.560	0.479	0.545	0.455

U0= 35.00 CM/S K= 0.930 1/SEC KLmf/Uo= 1.116

I	Hn	SIZE	UB	EPSIL	DELTA	KBE
1	2.61	5.22	45.79	0.890	0.817	2.11
2	8.40	6.35	50.51	0.890	0.817	1.73
3	15.21	7.27	54.05	0.890	0.817	1.51
4	22.82	7.94	56.49	0.890	0.817	1.38
5	30.99	8.40	58.08	0.890	0.817	1.31
6	39.53	8.69	59.08	0.890	0.817	1.27
7	48.31	8.87	59.69	0.894	0.823	1.24
8	57.24	8.98	60.06	0.899	0.831	1.22
9	66.25	9.05	60.29	0.903	0.839	1.22
10	75.32	9.09	60.42	0.908	0.847	1.21
11	84.42	9.11	60.49	0.912	0.854	1.21
12	93.54	9.12	60.54	0.916	0.861	1.21
13	102.67	9.13	60.57	0.920	0.867	1.20
14	111.80	9.14	60.58	0.924	0.874	1.20
15	120.94	9.14	60.59	0.928	0.880	1.20
16	130.08	9.14	60.60	0.931	0.886	1.20
17	139.23	9.14	60.60	0.935	0.891	1.20
18	148.37	9.14	60.60	0.938	0.896	1.20
19	157.51	9.14	60.61	0.941	0.901	1.20
20	166.66	9.14	60.61	0.944	0.906	1.20
21	175.80	9.14	60.61	0.946	0.910	1.20
22	184.95	9.14	60.61	0.949	0.915	1.20
23	194.09	9.14	60.61	0.951	0.919	1.20
24	203.24	9.14	60.61	0.954	0.923	1.20
25	212.38	9.14	60.61	0.956	0.926	1.20
26	221.52	9.14	60.61	0.958	0.930	1.20
27	227.58	2.97	34.55	0.959	0.932	3.70

I	Hn	U0-UMF	Q	Us	B	EMF	CAL EMF
1	2.61	34.690	37.397	-182.00	13.924	0.400	-0.088
2	8.40	34.690	41.253	-200.76	5.887	0.400	-0.295
3	15.21	34.690	44.138	-214.80	4.310	0.400	-0.552
4	22.82	34.690	46.131	-224.51	3.698	0.400	-0.835
5	30.99	34.690	47.432	-230.84	3.404	0.400	-1.106
6	39.53	34.690	48.249	-234.81	3.250	0.400	-1.334
7	48.31	34.690	49.112	-211.83	2.661	0.400	-6.218
8	57.24	34.690	49.913	-186.49	2.114	0.400	2.587
9	66.25	34.690	50.576	-167.42	1.731	0.400	1.301
10	75.32	34.690	51.147	-152.62	1.450	0.400	0.953
11	84.42	34.690	51.653	-140.87	1.236	0.400	0.791
12	93.54	34.690	52.114	-131.33	1.068	0.400	0.698
13	102.67	34.690	52.539	-123.46	0.933	0.400	0.638
14	111.80	34.690	52.935	-116.88	0.823	0.400	0.596
15	120.94	34.690	53.308	-111.29	0.731	0.400	0.565
16	130.08	34.690	53.661	-106.50	0.653	0.400	0.542
17	139.23	34.690	53.995	-102.36	0.588	0.400	0.523
18	148.37	34.690	54.312	-98.74	0.531	0.400	0.508
19	157.51	34.690	54.613	-95.56	0.482	0.400	0.495
20	166.66	34.690	54.899	-92.74	0.439	0.400	0.485
21	175.80	34.690	55.172	-90.24	0.401	0.400	0.476
22	184.95	34.690	55.432	-87.99	0.368	0.400	0.469
23	194.09	34.690	55.679	-85.97	0.338	0.400	0.463
24	203.24	34.690	55.914	-84.15	0.312	0.400	0.457
25	212.38	34.690	56.138	-82.50	0.288	0.400	0.452
26	221.52	34.690	56.351	-81.00	0.266	0.400	0.448
27	227.58	34.690	32.201	-45.65	-1.109	0.400	0.277

I	HHT	Hn	CB/CO	CE/CO	C/CO	CONV
1	5.22	2.61	1.000	0.923	0.986	0.014
2	11.57	8.40	0.980	0.921	0.969	0.031
3	18.85	15.21	0.966	0.880	0.950	0.050
4	26.79	22.82	0.948	0.853	0.930	0.070
5	35.19	30.99	0.929	0.827	0.910	0.090
6	43.88	39.53	0.909	0.803	0.890	0.110
7	52.75	48.31	0.889	0.781	0.870	0.130
8	61.73	57.24	0.869	0.765	0.851	0.149
9	70.78	66.25	0.850	0.751	0.834	0.166
10	79.87	75.32	0.832	0.739	0.818	0.182
11	88.98	84.42	0.815	0.728	0.802	0.198
12	98.10	93.54	0.799	0.717	0.788	0.212
13	107.23	102.67	0.784	0.707	0.774	0.226
14	116.37	111.80	0.770	0.698	0.761	0.239
15	125.51	120.94	0.757	0.690	0.749	0.251
16	134.65	130.08	0.745	0.682	0.738	0.262
17	143.80	139.23	0.733	0.674	0.727	0.273
18	152.94	148.37	0.723	0.667	0.717	0.283
19	162.09	157.51	0.713	0.660	0.707	0.293
20	171.23	166.66	0.703	0.654	0.698	0.302

21	180.37	175.80	0.694	0.648	0.690	0.310
22	189.52	184.95	0.686	0.642	0.682	0.318
23	198.66	194.09	0.678	0.637	0.674	0.326
24	207.81	203.24	0.670	0.631	0.667	0.333
25	216.95	212.38	0.663	0.627	0.661	0.339
26	226.10	221.52	0.657	0.622	0.654	0.346
27	229.07	227.58	0.652	0.647	0.652	0.348

APPENDIX D-1

COMPUTER OUTPUT BASED ON KATO-WEN MODEL (FRYER)

UO= 2.17 CM/S K= 0.330 1/SEC KLmf/Uo= 3.513

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	1.268	1.268	0.947	0.275	0.285	0.715
2	1.340	2.608	0.895	0.250	0.260	0.740
3	1.416	4.024	0.846	0.227	0.236	0.764
4	1.497	5.521	0.799	0.206	0.215	0.785
5	1.582	7.104	0.754	0.186	0.195	0.805
6	1.673	8.776	0.710	0.168	0.176	0.824
7	1.768	10.544	0.669	0.152	0.160	0.840
8	1.869	12.413	0.630	0.137	0.144	0.856
9	1.975	14.388	0.592	0.123	0.130	0.870
10	2.088	16.476	0.557	0.111	0.117	0.883
11	2.207	18.682	0.523	0.099	0.106	0.894
12	2.332	21.015	0.491	0.089	0.095	0.905
13	2.442	23.456	0.461	0.081	0.086	0.914

UO= 2.67 CM/S K= 0.330 1/SEC KLmf/Uo= 2.855

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	1.541	1.541	0.931	0.362	0.378	0.622
2	1.649	3.190	0.866	0.322	0.337	0.663
3	1.766	4.956	0.804	0.286	0.301	0.699
4	1.890	6.846	0.744	0.254	0.267	0.733
5	2.024	8.870	0.689	0.224	0.237	0.763
6	2.167	11.037	0.636	0.197	0.210	0.790
7	2.320	13.357	0.586	0.173	0.185	0.815
8	2.483	15.840	0.539	0.152	0.163	0.837
9	2.659	18.499	0.495	0.133	0.143	0.857
10	2.846	21.345	0.455	0.116	0.125	0.875
11	2.422	23.767	0.419	0.120	0.128	0.872

UO= 4.27 CM/S K= 0.330 1/SEC KLmf/Uo= 1.785

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	1.621	1.621	0.933	0.556	0.581	0.419
2	1.808	3.428	0.867	0.493	0.517	0.483
3	2.016	5.444	0.802	0.434	0.458	0.542
4	2.248	7.693	0.739	0.379	0.403	0.597
5	2.508	10.200	0.677	0.329	0.352	0.648
6	2.797	12.997	0.618	0.283	0.305	0.695
7	3.119	16.117	0.562	0.242	0.263	0.737
8	3.479	19.596	0.508	0.205	0.225	0.775
9	3.880	23.476	0.458	0.173	0.191	0.809
10	1.220	24.696	0.432	0.287	0.296	0.704

U0= 4.80 CM/S K= 0.330 1/SEC KLmf/Uo= 1.588

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	1.907	1.907	0.932	0.546	0.573	0.427
2	2.156	4.063	0.864	0.479	0.507	0.493
3	2.438	6.501	0.797	0.417	0.445	0.555
4	2.756	9.257	0.732	0.360	0.387	0.613
5	3.116	12.373	0.669	0.308	0.334	0.666
6	3.523	15.895	0.608	0.262	0.287	0.713
7	3.983	19.878	0.550	0.220	0.244	0.756
8	4.502	24.380	0.495	0.184	0.206	0.794
9	0.516	24.896	0.481	0.407	0.413	0.587

U0= 8.00 CM/S K= 0.330 1/SEC KLmf/Uo= 0.953

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	3.592	3.592	0.932	0.500	0.546	0.454
2	4.409	8.001	0.861	0.417	0.465	0.535
3	5.412	13.414	0.790	0.342	0.390	0.610
4	6.644	20.057	0.720	0.275	0.323	0.677
5	5.809	25.866	0.659	0.273	0.315	0.685

U0= 10.13 CM/S K= 0.330 1/SEC KLmf/Uo= 0.753

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	4.717	4.717	0.933	0.477	0.534	0.466
2	6.118	10.836	0.863	0.384	0.444	0.556
3	7.936	18.772	0.791	0.302	0.363	0.637
4	7.612	26.384	0.727	0.284	0.339	0.661

APPENDIX D-2

COMPUTER OUTPUT BASED ON KATO-WEN MODEL (CALDERBANK)

U0= 5.75 CM/S K= 0.029 1/SEC KLmf/Uo= 0.500

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.016	0.016	1.000	0.999	0.999	0.001
2	0.018	0.034	1.000	0.998	0.998	0.002
3	0.020	0.054	1.000	0.998	0.998	0.002
4	0.022	0.077	1.000	0.998	0.998	0.002
5	0.025	0.102	1.000	0.997	0.998	0.002
6	0.028	0.130	0.999	0.997	0.997	0.003
7	0.031	0.161	0.999	0.997	0.997	0.003
8	0.035	0.196	0.999	0.996	0.996	0.004
9	0.039	0.234	0.999	0.996	0.996	0.004
10	0.043	0.278	0.999	0.995	0.995	0.005
11	0.048	0.326	0.998	0.994	0.994	0.006
12	0.054	0.379	0.998	0.993	0.994	0.006
13	0.060	0.439	0.998	0.993	0.993	0.007
14	0.067	0.506	0.998	0.991	0.992	0.008
15	0.074	0.580	0.997	0.990	0.990	0.010
16	0.083	0.663	0.997	0.988	0.989	0.011
17	0.092	0.755	0.996	0.986	0.987	0.013
18	0.103	0.858	0.996	0.983	0.984	0.016
19	0.115	0.972	0.995	0.978	0.979	0.021
20	0.128	1.100	0.995	0.962	0.963	0.037
21	0.142	1.242	0.995	1.071	1.069	-0.069
22	0.159	1.401	0.994	1.001	1.001	-0.001
23	0.177	1.578	0.993	0.992	0.992	0.008
24	0.197	1.776	0.992	0.987	0.987	0.013
25	0.220	1.996	0.991	0.983	0.983	0.017
26	0.245	2.241	0.990	0.979	0.980	0.020
27	0.273	2.514	0.988	0.976	0.976	0.024
28	0.305	2.819	0.987	0.972	0.972	0.028
29	0.340	3.159	0.985	0.968	0.968	0.032
30	0.379	3.537	0.984	0.963	0.964	0.036
31	0.422	3.959	0.982	0.959	0.960	0.040
32	0.471	4.430	0.979	0.953	0.954	0.046
33	0.525	4.955	0.977	0.948	0.949	0.051
34	0.585	5.539	0.974	0.941	0.943	0.057
35	0.652	6.191	0.971	0.934	0.936	0.064
36	0.727	6.918	0.968	0.927	0.928	0.072
37	0.810	7.728	0.964	0.918	0.920	0.080
38	0.903	8.631	0.960	0.909	0.911	0.089
39	1.007	9.638	0.956	0.899	0.901	0.099
40	1.122	10.760	0.951	0.888	0.891	0.109
41	1.251	12.011	0.946	0.876	0.879	0.121
42	1.394	13.405	0.940	0.863	0.866	0.134
43	1.554	14.959	0.934	0.849	0.852	0.148
44	1.733	16.692	0.927	0.834	0.837	0.163
45	1.932	18.624	0.919	0.817	0.821	0.179
46	2.153	20.777	0.910	0.799	0.803	0.197
47	2.400	23.178	0.901	0.780	0.784	0.216

48	2.676	25.853	0.891	0.759	0.764	0.236
49	2.983	28.836	0.881	0.737	0.742	0.258
50	3.325	32.162	0.869	0.714	0.720	0.280
51	3.707	35.868	0.857	0.689	0.695	0.305
52	4.132	40.000	0.843	0.663	0.670	0.330
53	4.606	44.607	0.829	0.636	0.643	0.357
54	5.135	49.742	0.814	0.608	0.616	0.384
55	5.724	55.466	0.797	0.579	0.587	0.413
56	6.381	61.847	0.780	0.549	0.557	0.443
57	7.113	68.960	0.762	0.518	0.527	0.473
58	7.929	76.889	0.743	0.487	0.497	0.503
59	8.839	85.728	0.723	0.456	0.466	0.534
60	9.854	95.582	0.703	0.425	0.435	0.565
61	7.349	102.931	0.686	0.462	0.470	0.530

U0= 5.75 CM/S K= 0.064 1/SEC KLmf/Uo= 1.103

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.016	0.016	1.000	0.997	0.997	0.003
2	0.018	0.034	1.000	0.996	0.997	0.003
3	0.020	0.054	0.999	0.996	0.996	0.004
4	0.022	0.077	0.999	0.995	0.995	0.005
5	0.025	0.102	0.999	0.994	0.995	0.005
6	0.028	0.130	0.999	0.994	0.994	0.006
7	0.031	0.161	0.998	0.993	0.993	0.007
8	0.035	0.196	0.998	0.992	0.992	0.008
9	0.039	0.234	0.998	0.990	0.991	0.009
10	0.043	0.278	0.997	0.989	0.989	0.011
11	0.048	0.326	0.997	0.987	0.988	0.012
12	0.054	0.379	0.996	0.986	0.986	0.014
13	0.060	0.439	0.995	0.984	0.984	0.016
14	0.067	0.506	0.995	0.981	0.982	0.018
15	0.074	0.580	0.994	0.978	0.979	0.021
16	0.083	0.663	0.993	0.975	0.976	0.024
17	0.092	0.755	0.992	0.970	0.971	0.029
18	0.103	0.858	0.991	0.964	0.965	0.035
19	0.115	0.972	0.990	0.953	0.954	0.046
20	0.128	1.100	0.989	0.920	0.922	0.078
21	0.142	1.242	0.990	1.176	1.169	-0.169
22	0.159	1.401	0.988	1.004	1.003	-0.003
23	0.177	1.578	0.986	0.983	0.984	0.016
24	0.197	1.776	0.984	0.973	0.973	0.027
25	0.220	1.996	0.982	0.964	0.965	0.035
26	0.245	2.241	0.979	0.957	0.957	0.043
27	0.273	2.514	0.976	0.949	0.950	0.050
28	0.305	2.819	0.973	0.941	0.942	0.058
29	0.340	3.159	0.970	0.932	0.934	0.066
30	0.379	3.537	0.966	0.923	0.925	0.075
31	0.422	3.959	0.962	0.913	0.915	0.085

32	0.471	4.430	0.957	0.903	0.905	0.095
33	0.525	4.955	0.952	0.891	0.894	0.106
34	0.585	5.539	0.947	0.879	0.881	0.119
35	0.652	6.191	0.941	0.865	0.868	0.132
36	0.727	6.918	0.934	0.850	0.853	0.147
37	0.810	7.728	0.927	0.834	0.838	0.162
38	0.903	8.631	0.919	0.817	0.821	0.179
39	1.007	9.638	0.910	0.799	0.803	0.197
40	1.122	10.760	0.900	0.779	0.783	0.217
41	1.251	12.011	0.890	0.757	0.762	0.238
42	1.394	13.405	0.879	0.735	0.740	0.260
43	1.554	14.959	0.867	0.711	0.717	0.283
44	1.733	16.692	0.854	0.686	0.692	0.308
45	1.932	18.624	0.841	0.659	0.666	0.334
46	2.153	20.777	0.826	0.631	0.639	0.361
47	2.400	23.178	0.810	0.603	0.610	0.390
48	2.676	25.853	0.793	0.573	0.581	0.419
49	2.983	28.836	0.776	0.543	0.551	0.449
50	3.325	32.162	0.757	0.512	0.521	0.479
51	3.707	35.868	0.738	0.480	0.490	0.510
52	4.132	40.000	0.718	0.449	0.459	0.541
53	4.606	44.607	0.697	0.418	0.428	0.572
54	5.135	49.742	0.675	0.387	0.397	0.603
55	5.724	55.466	0.653	0.356	0.367	0.633
56	6.381	61.847	0.630	0.326	0.338	0.662
57	7.113	68.960	0.607	0.298	0.309	0.691
58	7.929	76.889	0.584	0.270	0.282	0.718
59	8.839	85.728	0.560	0.244	0.256	0.744
60	9.854	95.582	0.536	0.219	0.231	0.769
61	7.349	102.931	0.516	0.249	0.259	0.741

U0= 5.75 CM/S K= 0.122 1/SEC KLmf/Uo= 2.102

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.016	0.016	1.000	0.994	0.994	0.006
2	0.018	0.034	0.999	0.993	0.993	0.007
3	0.020	0.054	0.999	0.992	0.992	0.008
4	0.022	0.077	0.998	0.991	0.991	0.009
5	0.025	0.102	0.998	0.989	0.990	0.010
6	0.028	0.130	0.997	0.988	0.988	0.012
7	0.031	0.161	0.997	0.986	0.986	0.014
8	0.035	0.196	0.996	0.984	0.985	0.015
9	0.039	0.234	0.995	0.982	0.982	0.018
10	0.043	0.278	0.994	0.979	0.980	0.020
11	0.048	0.326	0.993	0.976	0.977	0.023
12	0.054	0.379	0.992	0.973	0.974	0.026
13	0.060	0.439	0.991	0.969	0.970	0.030
14	0.067	0.506	0.990	0.965	0.966	0.034
15	0.074	0.580	0.989	0.959	0.961	0.039

16	0.083	0.663	0.987	0.953	0.954	0.046
17	0.092	0.755	0.985	0.945	0.946	0.054
18	0.103	0.858	0.983	0.933	0.935	0.065
19	0.115	0.972	0.981	0.913	0.916	0.084
20	0.128	1.100	0.980	0.857	0.862	0.138
21	0.142	1.242	0.987	1.413	1.397	-0.397
22	0.159	1.401	0.983	1.014	1.013	-0.013
23	0.177	1.578	0.980	0.975	0.975	0.025
24	0.197	1.776	0.976	0.955	0.956	0.044
25	0.220	1.996	0.972	0.939	0.941	0.059
26	0.245	2.241	0.967	0.925	0.927	0.073
27	0.273	2.514	0.962	0.912	0.913	0.087
28	0.305	2.819	0.956	0.897	0.900	0.100
29	0.340	3.159	0.950	0.882	0.885	0.115
30	0.379	3.537	0.943	0.867	0.870	0.130
31	0.422	3.959	0.936	0.850	0.853	0.147
32	0.471	4.430	0.928	0.832	0.835	0.165
33	0.525	4.955	0.919	0.813	0.817	0.183
34	0.585	5.539	0.909	0.792	0.797	0.203
35	0.652	6.191	0.899	0.770	0.775	0.225
36	0.727	6.918	0.887	0.747	0.753	0.247
37	0.810	7.728	0.875	0.723	0.728	0.272
38	0.903	8.631	0.862	0.697	0.703	0.297
39	1.007	9.638	0.848	0.670	0.677	0.323
40	1.122	10.760	0.833	0.642	0.649	0.351
41	1.251	12.011	0.817	0.612	0.620	0.380
42	1.394	13.405	0.800	0.582	0.590	0.410
43	1.554	14.959	0.782	0.551	0.560	0.440
44	1.733	16.692	0.764	0.520	0.529	0.471
45	1.932	18.624	0.744	0.488	0.498	0.502
46	2.153	20.777	0.723	0.456	0.466	0.534
47	2.400	23.178	0.702	0.424	0.434	0.566
48	2.676	25.853	0.680	0.392	0.403	0.597
49	2.983	28.836	0.658	0.361	0.373	0.627
50	3.325	32.162	0.634	0.331	0.343	0.657
51	3.707	35.868	0.611	0.302	0.314	0.686
52	4.132	40.000	0.587	0.274	0.286	0.714
53	4.606	44.607	0.563	0.247	0.259	0.741
54	5.135	49.742	0.539	0.222	0.234	0.766
55	5.724	55.466	0.515	0.199	0.211	0.789
56	6.381	61.847	0.491	0.177	0.189	0.811
57	7.113	68.960	0.467	0.157	0.169	0.831
58	7.929	76.889	0.444	0.138	0.150	0.850
59	8.839	85.728	0.421	0.122	0.133	0.867
60	9.854	95.582	0.399	0.106	0.117	0.883
61	7.349	102.931	0.380	0.125	0.134	0.866

U0= 5.75 CM/S K= 0.302 1/SEC KLmf/Uo= 5.203

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	0.016	0.016	0.999	0.986	0.986	0.014
2	0.018	0.034	0.998	0.984	0.984	0.016
3	0.020	0.054	0.997	0.981	0.981	0.019
4	0.022	0.077	0.996	0.978	0.978	0.022
5	0.025	0.102	0.995	0.974	0.975	0.025
6	0.028	0.130	0.994	0.971	0.971	0.029
7	0.031	0.161	0.992	0.966	0.967	0.033
8	0.035	0.196	0.990	0.961	0.963	0.037
9	0.039	0.234	0.989	0.956	0.957	0.043
10	0.043	0.278	0.987	0.950	0.951	0.049
11	0.048	0.326	0.984	0.943	0.945	0.055
12	0.054	0.379	0.982	0.936	0.937	0.063
13	0.060	0.439	0.979	0.927	0.929	0.071
14	0.067	0.506	0.976	0.917	0.919	0.081
15	0.074	0.580	0.973	0.905	0.907	0.093
16	0.083	0.663	0.969	0.891	0.894	0.106
17	0.092	0.755	0.965	0.873	0.876	0.124
18	0.103	0.858	0.961	0.848	0.853	0.147
19	0.115	0.972	0.958	0.808	0.814	0.186
20	0.128	1.100	0.958	0.707	0.717	0.283
21	0.142	1.242	1.130	4.478	4.352	-3.352
22	0.159	1.401	1.121	1.211	1.208	-0.208
23	0.177	1.578	1.112	1.098	1.098	-0.098
24	0.197	1.776	1.101	1.044	1.046	-0.046
25	0.220	1.996	1.089	1.004	1.007	-0.007
26	0.245	2.241	1.077	0.969	0.973	0.027
27	0.273	2.514	1.063	0.936	0.940	0.060
28	0.305	2.819	1.049	0.903	0.908	0.092
29	0.340	3.159	1.033	0.869	0.875	0.125
30	0.379	3.537	1.017	0.835	0.841	0.159
31	0.422	3.959	0.999	0.799	0.807	0.193
32	0.471	4.430	0.980	0.763	0.771	0.229
33	0.525	4.955	0.960	0.726	0.735	0.265
34	0.585	5.539	0.939	0.688	0.697	0.303
35	0.652	6.191	0.917	0.649	0.659	0.341
36	0.727	6.918	0.893	0.610	0.621	0.379
37	0.810	7.728	0.869	0.571	0.582	0.418
38	0.903	8.631	0.844	0.532	0.543	0.457
39	1.007	9.638	0.817	0.493	0.505	0.495
40	1.122	10.760	0.790	0.455	0.467	0.533
41	1.251	12.011	0.763	0.417	0.430	0.570
42	1.394	13.405	0.735	0.381	0.394	0.606
43	1.554	14.959	0.706	0.346	0.360	0.640
44	1.733	16.692	0.677	0.313	0.327	0.673
45	1.932	18.624	0.648	0.282	0.296	0.704
46	2.153	20.777	0.619	0.252	0.266	0.734
47	2.400	23.178	0.590	0.225	0.239	0.761

48	2.676	25.853	0.561	0.199	0.213	0.787
49	2.983	28.836	0.533	0.176	0.189	0.811
50	3.325	32.162	0.505	0.155	0.168	0.832
51	3.707	35.868	0.478	0.135	0.148	0.852
52	4.132	40.000	0.452	0.118	0.131	0.869
53	4.606	44.607	0.426	0.102	0.115	0.885
54	5.135	49.742	0.401	0.089	0.100	0.900
55	5.724	55.466	0.377	0.076	0.088	0.912
56	6.381	61.847	0.354	0.066	0.076	0.924
57	7.113	68.960	0.332	0.056	0.067	0.933
58	7.929	76.889	0.311	0.048	0.058	0.942
59	8.839	85.728	0.291	0.041	0.050	0.950
60	9.854	95.582	0.271	0.035	0.044	0.956
61	7.349	102.931	0.254	0.042	0.050	0.950

U0= 5.75 CM/S K= 0.668 1/SEC KLmf/Uo=11.508

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.016	0.016	0.998	0.969	0.971	0.029
2	0.018	0.034	0.996	0.964	0.965	0.035
3	0.020	0.054	0.994	0.958	0.960	0.040
4	0.022	0.077	0.992	0.952	0.954	0.046
5	0.025	0.102	0.989	0.945	0.947	0.053
6	0.028	0.130	0.986	0.937	0.939	0.061
7	0.031	0.161	0.983	0.928	0.930	0.070
8	0.035	0.196	0.980	0.918	0.921	0.079
9	0.039	0.234	0.976	0.908	0.910	0.090
10	0.043	0.278	0.972	0.896	0.898	0.102
11	0.048	0.326	0.967	0.882	0.885	0.115
12	0.054	0.379	0.962	0.867	0.871	0.129
13	0.060	0.439	0.956	0.851	0.855	0.145
14	0.067	0.506	0.951	0.832	0.836	0.164
15	0.074	0.580	0.944	0.810	0.815	0.185
16	0.083	0.663	0.938	0.785	0.791	0.209
17	0.092	0.755	0.931	0.754	0.761	0.239
18	0.103	0.858	0.925	0.714	0.722	0.278
19	0.115	0.972	0.921	0.654	0.664	0.336
20	0.128	1.100	0.931	0.522	0.537	0.463
21	0.142	1.242	0.707	-1.081	-1.014	2.014
22	0.159	1.401	0.696	0.833	0.828	0.172
23	0.177	1.578	0.683	0.664	0.665	0.335
24	0.197	1.776	0.669	0.597	0.599	0.401
25	0.220	1.996	0.654	0.551	0.554	0.446
26	0.245	2.241	0.639	0.513	0.517	0.483
27	0.273	2.514	0.623	0.478	0.484	0.516
28	0.305	2.819	0.606	0.446	0.452	0.548
29	0.340	3.159	0.589	0.415	0.422	0.578
30	0.379	3.537	0.571	0.385	0.392	0.608
31	0.422	3.959	0.553	0.356	0.364	0.636

32	0.471	4.430	0.534	0.328	0.336	0.664
33	0.525	4.955	0.515	0.300	0.309	0.691
34	0.585	5.539	0.496	0.274	0.282	0.718
35	0.652	6.191	0.476	0.249	0.257	0.743
36	0.727	6.918	0.456	0.225	0.234	0.766
37	0.810	7.728	0.436	0.202	0.211	0.789
38	0.903	8.631	0.416	0.181	0.190	0.810
39	1.007	9.638	0.396	0.161	0.170	0.830
40	1.122	10.760	0.376	0.143	0.152	0.848
41	1.251	12.011	0.356	0.126	0.135	0.865
42	1.394	13.405	0.337	0.111	0.119	0.881
43	1.554	14.959	0.319	0.097	0.105	0.895
44	1.733	16.692	0.300	0.084	0.092	0.908
45	1.932	18.624	0.283	0.073	0.081	0.919
46	2.153	20.777	0.265	0.063	0.071	0.929
47	2.400	23.178	0.249	0.054	0.062	0.938
48	2.676	25.853	0.233	0.046	0.054	0.946
49	2.983	28.836	0.218	0.040	0.046	0.954
50	3.325	32.162	0.204	0.034	0.040	0.960
51	3.707	35.868	0.190	0.029	0.035	0.965
52	4.132	40.000	0.177	0.024	0.030	0.970
53	4.606	44.607	0.164	0.021	0.026	0.974
54	5.135	49.742	0.152	0.017	0.022	0.978
55	5.724	55.466	0.141	0.015	0.019	0.981
56	6.381	61.847	0.131	0.012	0.017	0.983
57	7.113	68.960	0.121	0.010	0.014	0.986
58	7.929	76.889	0.112	0.009	0.012	0.988
59	8.839	85.728	0.103	0.007	0.011	0.989
60	9.854	95.582	0.095	0.006	0.009	0.991
61	7.349	102.931	0.088	0.007	0.010	0.990

U0= 5.75 CM/S K= 1.248 1/SEC KLmf/Uo=21.500

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.016	0.016	0.997	0.944	0.946	0.054
2	0.018	0.034	0.993	0.935	0.937	0.063
3	0.020	0.054	0.989	0.925	0.928	0.072
4	0.022	0.077	0.985	0.914	0.917	0.083
5	0.025	0.102	0.981	0.902	0.905	0.095
6	0.028	0.130	0.976	0.888	0.892	0.108
7	0.031	0.161	0.970	0.873	0.877	0.123
8	0.035	0.196	0.964	0.857	0.861	0.139
9	0.039	0.234	0.957	0.840	0.844	0.156
10	0.043	0.278	0.950	0.820	0.825	0.175
11	0.048	0.326	0.943	0.799	0.805	0.195
12	0.054	0.379	0.935	0.776	0.782	0.218
13	0.060	0.439	0.926	0.751	0.758	0.242
14	0.067	0.506	0.917	0.724	0.731	0.269
15	0.074	0.580	0.908	0.693	0.701	0.299

16	0.083	0.663	0.898	0.659	0.668	0.332
17	0.092	0.755	0.890	0.619	0.629	0.371
18	0.103	0.858	0.883	0.569	0.581	0.419
19	0.115	0.972	0.883	0.501	0.515	0.485
20	0.128	1.100	0.916	0.372	0.392	0.608
21	0.142	1.242	0.674	-0.323	-0.285	1.285
22	0.159	1.401	0.659	0.950	0.939	0.061
23	0.177	1.578	0.636	0.605	0.606	0.394
24	0.197	1.776	0.612	0.500	0.504	0.496
25	0.220	1.996	0.589	0.436	0.442	0.558
26	0.245	2.241	0.566	0.388	0.394	0.606
27	0.273	2.514	0.543	0.347	0.354	0.646
28	0.305	2.819	0.520	0.311	0.319	0.681
29	0.340	3.159	0.497	0.279	0.287	0.713
30	0.379	3.537	0.474	0.249	0.258	0.742
31	0.422	3.959	0.451	0.222	0.231	0.769
32	0.471	4.430	0.429	0.197	0.206	0.794
33	0.525	4.955	0.406	0.174	0.183	0.817
34	0.585	5.539	0.385	0.153	0.162	0.838
35	0.652	6.191	0.363	0.134	0.143	0.857
36	0.727	6.918	0.342	0.117	0.126	0.874
37	0.810	7.728	0.322	0.102	0.110	0.890
38	0.903	8.631	0.302	0.088	0.096	0.904
39	1.007	9.638	0.283	0.076	0.084	0.916
40	1.122	10.760	0.265	0.065	0.073	0.927
41	1.251	12.011	0.247	0.056	0.063	0.937
42	1.394	13.405	0.231	0.048	0.055	0.945
43	1.554	14.959	0.215	0.041	0.047	0.953
44	1.733	16.692	0.199	0.034	0.041	0.959
45	1.932	18.624	0.185	0.029	0.035	0.965
46	2.153	20.777	0.171	0.024	0.030	0.970
47	2.400	23.178	0.158	0.021	0.026	0.974
48	2.676	25.853	0.146	0.017	0.022	0.978
49	2.983	28.836	0.135	0.014	0.019	0.981
50	3.325	32.162	0.124	0.012	0.016	0.984
51	3.707	35.868	0.114	0.010	0.014	0.986
52	4.132	40.000	0.105	0.008	0.012	0.988
53	4.606	44.607	0.096	0.007	0.010	0.990
54	5.135	49.742	0.088	0.006	0.009	0.991
55	5.724	55.466	0.081	0.005	0.008	0.992
56	6.381	61.847	0.074	0.004	0.006	0.994
57	7.113	68.960	0.067	0.003	0.006	0.994
58	7.929	76.889	0.061	0.003	0.005	0.995
59	8.839	85.728	0.056	0.002	0.004	0.996
60	9.854	95.582	0.050	0.002	0.004	0.996
61	7.349	102.931	0.046	0.002	0.004	0.996

APPENDIX D-3

COMPUTER OUTPUT BASED ON KATO-WEN MODEL (KOBAYASHI)

U0= 5.00 CM/S K= 0.600 1/SEC KLmf/Uo= 8.040

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.060	0.060	0.999	1.244	1.230	-0.230
2	0.069	0.129	0.992	1.027	1.025	-0.025
3	0.080	0.209	0.983	0.975	0.976	0.024
4	0.092	0.301	0.973	0.942	0.944	0.056
5	0.106	0.407	0.961	0.914	0.916	0.084
6	0.122	0.530	0.949	0.886	0.889	0.111
7	0.141	0.671	0.935	0.857	0.861	0.139
8	0.163	0.833	0.919	0.826	0.831	0.169
9	0.188	1.021	0.902	0.794	0.800	0.200
10	0.216	1.238	0.882	0.759	0.766	0.234
11	0.250	1.487	0.861	0.722	0.730	0.270
12	0.288	1.775	0.838	0.683	0.692	0.308
13	0.332	2.107	0.814	0.642	0.651	0.349
14	0.383	2.490	0.787	0.599	0.609	0.391
15	0.441	2.931	0.758	0.555	0.566	0.434
16	0.509	3.440	0.727	0.510	0.522	0.478
17	0.587	4.027	0.695	0.465	0.477	0.523
18	0.677	4.703	0.662	0.419	0.433	0.567
19	0.780	5.484	0.627	0.375	0.389	0.611
20	0.900	6.384	0.592	0.333	0.347	0.653
21	1.038	7.422	0.556	0.292	0.307	0.693
22	1.197	8.618	0.520	0.254	0.269	0.731
23	1.380	9.998	0.484	0.219	0.233	0.767
24	1.591	11.590	0.448	0.186	0.201	0.799
25	1.835	13.425	0.413	0.158	0.172	0.828
26	2.116	15.541	0.380	0.132	0.146	0.854
27	2.440	17.981	0.347	0.109	0.123	0.877
28	2.814	20.795	0.316	0.090	0.103	0.897
29	3.245	24.040	0.287	0.074	0.086	0.914
30	3.742	27.782	0.260	0.060	0.071	0.929
31	4.315	32.097	0.234	0.048	0.058	0.942
32	4.976	37.074	0.211	0.038	0.048	0.952
33	5.738	42.812	0.189	0.031	0.039	0.961
34	6.617	49.429	0.169	0.024	0.032	0.968
35	7.631	57.060	0.150	0.019	0.026	0.974
36	8.799	65.859	0.134	0.015	0.022	0.978
37	5.115	70.974	0.120	0.021	0.027	0.973

U0= 10.00 CM/S K= 0.600 1/SEC KLmf/Uo= 4.020

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.097	0.097	0.995	0.998	0.998	0.002
2	0.129	0.226	0.988	0.967	0.969	0.031
3	0.172	0.398	0.979	0.937	0.941	0.059
4	0.229	0.628	0.968	0.902	0.909	0.091
5	0.305	0.933	0.953	0.860	0.870	0.130

6	0.407	1.339	0.935	0.810	0.823	0.177
7	0.541	1.881	0.912	0.750	0.767	0.233
8	0.721	2.602	0.885	0.682	0.702	0.298
9	0.960	3.562	0.852	0.605	0.631	0.369
10	1.279	4.840	0.814	0.524	0.554	0.446
11	1.703	6.543	0.772	0.441	0.475	0.525
12	2.268	8.811	0.725	0.360	0.398	0.602
13	3.020	11.830	0.675	0.286	0.326	0.674
14	4.021	15.852	0.623	0.220	0.262	0.738
15	5.356	21.207	0.571	0.165	0.207	0.793
16	7.132	28.339	0.519	0.121	0.162	0.838
17	9.498	37.837	0.469	0.087	0.126	0.874
18	12.649	50.486	0.422	0.061	0.098	0.902
19	16.845	67.331	0.377	0.043	0.077	0.923
20	7.336	74.666	0.342	0.078	0.105	0.895

U0= 15.00 CM/S K= 0.600 1/SEC KLmf/Uo= 2.680

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.129	0.129	0.996	0.990	0.991	0.009
2	0.199	0.327	0.989	0.956	0.960	0.040
3	0.306	0.634	0.979	0.913	0.922	0.078
4	0.473	1.106	0.964	0.855	0.869	0.131
5	0.729	1.835	0.944	0.777	0.799	0.201
6	1.125	2.960	0.916	0.679	0.711	0.289
7	1.735	4.695	0.880	0.565	0.607	0.393
8	2.676	7.371	0.836	0.444	0.496	0.504
9	4.128	11.500	0.785	0.329	0.390	0.610
10	6.368	17.868	0.729	0.230	0.296	0.704
11	9.824	27.691	0.670	0.153	0.222	0.778
12	15.154	42.845	0.611	0.098	0.166	0.834
13	23.376	66.221	0.553	0.060	0.126	0.874
14	11.008	77.230	0.507	0.106	0.159	0.841

U0= 20.00 CM/S K= 0.600 1/SEC KLmf/Uo= 2.010

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.161	0.161	0.996	0.986	0.987	0.013
2	0.290	0.451	0.989	0.943	0.950	0.050
3	0.520	0.971	0.977	0.878	0.893	0.107
4	0.934	1.905	0.958	0.780	0.807	0.193
5	1.677	3.582	0.929	0.646	0.690	0.310
6	3.010	6.592	0.889	0.489	0.551	0.449
7	5.405	11.997	0.839	0.335	0.413	0.587
8	9.704	21.701	0.781	0.208	0.297	0.703
9	17.422	39.122	0.720	0.120	0.213	0.787
10	31.278	70.401	0.656	0.065	0.157	0.843
11	8.899	79.299	0.613	0.174	0.242	0.758

APPENDIX D-4

COMPUTER OUTPUT BASED ON KATO-WEN MODEL (GRACE)

U0= 10.00 CM/S K= 0.100 1/SEC KLmf/Uo= 1.300

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	2.157	2.157	0.981	0.928	0.934	0.066
2	2.275	4.432	0.962	0.898	0.905	0.095
3	2.398	6.830	0.943	0.869	0.877	0.123
4	2.529	9.359	0.923	0.840	0.849	0.151
5	2.667	12.026	0.903	0.811	0.821	0.179
6	2.812	14.838	0.882	0.783	0.794	0.206
7	2.965	17.803	0.861	0.755	0.766	0.234
8	3.126	20.929	0.839	0.727	0.739	0.261
9	3.297	24.226	0.818	0.699	0.712	0.288
10	3.476	27.702	0.796	0.672	0.685	0.315
11	3.665	31.367	0.773	0.644	0.658	0.342
12	3.865	35.232	0.751	0.617	0.631	0.369
13	4.075	39.307	0.728	0.590	0.605	0.395
14	4.297	43.605	0.705	0.563	0.578	0.422
15	4.531	48.136	0.682	0.537	0.552	0.448
16	4.778	52.913	0.659	0.511	0.527	0.473
17	5.038	57.951	0.636	0.485	0.501	0.499
18	5.312	63.264	0.612	0.460	0.476	0.524
19	5.601	68.865	0.589	0.435	0.452	0.548
20	5.906	74.771	0.566	0.411	0.428	0.572
21	6.228	80.999	0.543	0.388	0.404	0.596
22	6.567	87.566	0.520	0.365	0.381	0.619
23	6.925	94.491	0.498	0.342	0.359	0.641
24	7.301	101.792	0.476	0.321	0.337	0.663
25	7.699	109.491	0.454	0.300	0.316	0.684
26	8.118	117.609	0.432	0.279	0.296	0.704
27	8.560	126.170	0.411	0.260	0.276	0.724
28	9.026	135.196	0.390	0.241	0.257	0.743
29	9.518	144.713	0.370	0.224	0.239	0.761
30	0.707	145.420	0.368	0.328	0.333	0.667

U0= 15.00 CM/S K= 0.100 1/SEC KLmf/Uo= 0.867

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	2.187	2.187	0.988	0.997	0.995	0.005
2	2.368	4.555	0.975	0.969	0.970	0.030
3	2.564	7.119	0.962	0.942	0.945	0.055
4	2.776	9.895	0.947	0.915	0.921	0.079
5	3.006	12.901	0.932	0.889	0.896	0.104
6	3.255	16.156	0.916	0.862	0.871	0.129
7	3.525	19.681	0.899	0.835	0.846	0.154
8	3.816	23.497	0.881	0.807	0.820	0.180
9	4.132	27.630	0.862	0.779	0.793	0.207
10	4.474	32.104	0.843	0.750	0.766	0.234
11	4.845	36.949	0.823	0.721	0.738	0.262
12	5.246	42.195	0.801	0.691	0.710	0.290

13	5.680	47.875	0.779	0.661	0.681	0.319
14	6.151	54.026	0.757	0.630	0.652	0.348
15	6.660	60.686	0.733	0.600	0.622	0.378
16	7.211	67.897	0.709	0.568	0.592	0.408
17	7.808	75.705	0.685	0.537	0.562	0.438
18	8.455	84.159	0.660	0.506	0.532	0.468
19	9.155	93.314	0.634	0.475	0.502	0.498
20	9.912	103.227	0.608	0.445	0.472	0.528
21	10.733	113.960	0.582	0.414	0.443	0.557
22	11.622	125.581	0.555	0.385	0.414	0.586
23	12.584	138.165	0.529	0.356	0.385	0.615
24	13.626	151.791	0.502	0.328	0.357	0.643
25	4.543	156.334	0.491	0.436	0.445	0.555

U0= 21.40 CM/S K= 0.100 1/SEC KLmf/Uo= 0.607

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	2.226	2.226	0.992	1.025	1.018	-0.018
2	2.494	4.720	0.983	0.998	0.995	0.005
3	2.794	7.514	0.973	0.972	0.972	0.028
4	3.130	10.644	0.962	0.946	0.950	0.050
5	3.506	14.150	0.950	0.920	0.927	0.073
6	3.928	18.077	0.937	0.894	0.903	0.097
7	4.400	22.477	0.923	0.866	0.878	0.122
8	4.929	27.406	0.907	0.837	0.852	0.148
9	5.522	32.928	0.890	0.806	0.825	0.175
10	6.185	39.113	0.872	0.774	0.796	0.204
11	6.929	46.042	0.852	0.741	0.765	0.235
12	7.762	53.804	0.831	0.706	0.733	0.267
13	8.696	62.500	0.808	0.670	0.700	0.300
14	9.741	72.241	0.785	0.633	0.666	0.334
15	10.912	83.154	0.759	0.595	0.631	0.369
16	12.225	95.378	0.733	0.556	0.595	0.405
17	13.694	109.073	0.705	0.517	0.558	0.442
18	15.341	124.414	0.677	0.478	0.521	0.479
19	17.186	141.599	0.647	0.439	0.484	0.516
20	19.252	160.851	0.617	0.400	0.448	0.552
21	5.459	166.310	0.606	0.550	0.562	0.438

U0= 10.00 CM/S K= 0.150 1/SEC KLmf/Uo= 1.950

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	2.157	2.157	0.973	0.896	0.904	0.096
2	2.275	4.432	0.945	0.854	0.863	0.137
3	2.398	6.830	0.917	0.813	0.824	0.176
4	2.529	9.359	0.889	0.774	0.786	0.214
5	2.667	12.026	0.861	0.736	0.749	0.251
6	2.812	14.838	0.832	0.700	0.714	0.286

7	2.965	17.803	0.804	0.664	0.679	0.321
8	3.126	20.929	0.775	0.629	0.645	0.355
9	3.297	24.226	0.746	0.595	0.611	0.389
10	3.476	27.702	0.718	0.562	0.579	0.421
11	3.665	31.367	0.690	0.530	0.547	0.453
12	3.865	35.232	0.662	0.499	0.517	0.483
13	4.075	39.307	0.634	0.469	0.487	0.513
14	4.297	43.605	0.606	0.440	0.458	0.542
15	4.531	48.136	0.579	0.412	0.430	0.570
16	4.778	52.913	0.552	0.385	0.403	0.597
17	5.038	57.951	0.525	0.359	0.376	0.624
18	5.312	63.264	0.499	0.334	0.351	0.649
19	5.601	68.865	0.474	0.310	0.327	0.673
20	5.906	74.771	0.449	0.287	0.304	0.696
21	6.228	80.999	0.425	0.265	0.282	0.718
22	6.567	87.566	0.401	0.244	0.261	0.739
23	6.925	94.491	0.378	0.225	0.241	0.759
24	7.301	101.792	0.356	0.206	0.222	0.778
25	7.699	109.491	0.335	0.189	0.204	0.796
26	8.118	117.609	0.314	0.173	0.188	0.812
27	8.560	126.170	0.294	0.157	0.172	0.828
28	9.026	135.196	0.275	0.143	0.157	0.843
29	9.518	144.713	0.257	0.130	0.143	0.857
30	0.707	145.420	0.255	0.216	0.220	0.780

U0= 15.00 CM/S K= 0.150 1/SEC KLmf/Uo= 1.300

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	2.187	2.187	0.982	0.995	0.993	0.007
2	2.368	4.555	0.963	0.954	0.955	0.045
3	2.564	7.119	0.943	0.914	0.919	0.081
4	2.776	9.895	0.922	0.877	0.884	0.116
5	3.006	12.901	0.900	0.839	0.850	0.150
6	3.255	16.156	0.877	0.802	0.815	0.185
7	3.525	19.681	0.854	0.766	0.780	0.220
8	3.816	23.497	0.829	0.729	0.746	0.254
9	4.132	27.630	0.804	0.693	0.711	0.289
10	4.474	32.104	0.777	0.656	0.677	0.323
11	4.845	36.949	0.751	0.620	0.642	0.358
12	5.246	42.195	0.723	0.584	0.607	0.393
13	5.680	47.875	0.695	0.548	0.573	0.427
14	6.151	54.026	0.667	0.513	0.539	0.461
15	6.660	60.686	0.638	0.478	0.505	0.495
16	7.211	67.897	0.609	0.444	0.472	0.528
17	7.808	75.705	0.580	0.411	0.439	0.561
18	8.455	84.159	0.551	0.379	0.408	0.592
19	9.155	93.314	0.522	0.348	0.377	0.623
20	9.912	103.227	0.493	0.318	0.348	0.652
21	10.733	113.960	0.465	0.290	0.319	0.681

22	11.622	125.581	0.437	0.263	0.292	0.708
23	12.584	138.165	0.410	0.237	0.266	0.734
24	13.626	151.791	0.383	0.213	0.242	0.758
25	4.543	156.334	0.370	0.311	0.321	0.679

U0= 21.40 CM/S K= 0.150 1/SEC KLmf/Uo= 0.911

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	2.226	2.226	0.988	1.039	1.028	-0.028
2	2.494	4.720	0.975	0.997	0.992	0.008
3	2.794	7.514	0.960	0.958	0.959	0.041
4	3.130	10.644	0.944	0.921	0.926	0.074
5	3.506	14.150	0.927	0.884	0.893	0.107
6	3.928	18.077	0.908	0.846	0.859	0.141
7	4.400	22.477	0.887	0.808	0.825	0.175
8	4.929	27.406	0.865	0.768	0.790	0.210
9	5.522	32.928	0.842	0.728	0.753	0.247
10	6.185	39.113	0.817	0.687	0.715	0.285
11	6.929	46.042	0.790	0.645	0.677	0.323
12	7.762	53.804	0.763	0.603	0.638	0.362
13	8.696	62.500	0.734	0.560	0.598	0.402
14	9.741	72.241	0.704	0.518	0.558	0.442
15	10.912	83.154	0.673	0.475	0.518	0.482
16	12.225	95.378	0.641	0.434	0.479	0.521
17	13.694	109.073	0.608	0.393	0.440	0.560
18	15.341	124.414	0.576	0.354	0.402	0.598
19	17.186	141.599	0.543	0.317	0.366	0.634
20	19.252	160.851	0.510	0.281	0.331	0.669
21	5.459	166.310	0.496	0.430	0.445	0.555

U0= 10.00 CM/S K= 0.200 1/SEC KLmf/Uo= 2.600

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	2.157	2.157	0.964	0.865	0.876	0.124
2	2.275	4.432	0.928	0.812	0.825	0.175
3	2.398	6.830	0.893	0.763	0.776	0.224
4	2.529	9.359	0.857	0.716	0.731	0.269
5	2.667	12.026	0.822	0.671	0.687	0.313
6	2.812	14.838	0.787	0.628	0.645	0.355
7	2.965	17.803	0.753	0.588	0.605	0.395
8	3.126	20.929	0.718	0.549	0.567	0.433
9	3.297	24.226	0.685	0.512	0.530	0.470
10	3.476	27.702	0.652	0.476	0.495	0.505
11	3.665	31.367	0.620	0.442	0.461	0.539
12	3.865	35.232	0.588	0.410	0.429	0.571
13	4.075	39.307	0.557	0.380	0.399	0.601
14	4.297	43.605	0.527	0.351	0.369	0.631
15	4.531	48.136	0.498	0.323	0.342	0.658

16	4.778	52.913	0.469	0.297	0.315	0.685
17	5.038	57.951	0.442	0.273	0.291	0.709
18	5.312	63.264	0.415	0.250	0.267	0.733
19	5.601	68.865	0.389	0.228	0.245	0.755
20	5.906	74.771	0.364	0.208	0.224	0.776
21	6.228	80.999	0.341	0.189	0.205	0.795
22	6.567	87.566	0.318	0.171	0.187	0.813
23	6.925	94.491	0.296	0.155	0.170	0.830
24	7.301	101.792	0.276	0.140	0.154	0.846
25	7.699	109.491	0.256	0.126	0.140	0.860
26	8.118	117.609	0.237	0.113	0.127	0.873
27	8.560	126.170	0.220	0.102	0.114	0.886
28	9.026	135.196	0.203	0.091	0.103	0.897
29	9.518	144.713	0.187	0.081	0.092	0.908
30	0.707	145.420	0.186	0.150	0.154	0.846

U0= 15.00 CM/S K= 0.200 1/SEC KLmf/Uo= 1.733

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	2.187	2.187	0.976	0.993	0.990	0.010
2	2.368	4.555	0.951	0.939	0.941	0.059
3	2.564	7.119	0.925	0.888	0.894	0.106
4	2.776	9.895	0.898	0.840	0.850	0.150
5	3.006	12.901	0.870	0.793	0.806	0.194
6	3.255	16.156	0.841	0.748	0.764	0.236
7	3.525	19.681	0.811	0.704	0.722	0.278
8	3.816	23.497	0.781	0.660	0.681	0.319
9	4.132	27.630	0.750	0.618	0.640	0.360
10	4.474	32.104	0.719	0.577	0.601	0.399
11	4.845	36.949	0.687	0.536	0.562	0.438
12	5.246	42.195	0.655	0.497	0.524	0.476
13	5.680	47.875	0.623	0.459	0.487	0.513
14	6.151	54.026	0.591	0.422	0.451	0.549
15	6.660	60.686	0.560	0.387	0.416	0.584
16	7.211	67.897	0.528	0.353	0.383	0.617
17	7.808	75.705	0.497	0.321	0.351	0.649
18	8.455	84.159	0.466	0.290	0.320	0.680
19	9.155	93.314	0.437	0.262	0.291	0.709
20	9.912	103.227	0.407	0.235	0.264	0.736
21	10.733	113.960	0.379	0.210	0.238	0.762
22	11.622	125.581	0.352	0.187	0.215	0.785
23	12.584	138.165	0.326	0.165	0.192	0.808
24	13.626	151.791	0.301	0.146	0.172	0.828
25	4.543	156.334	0.288	0.230	0.240	0.760

U0= 21.40 CM/S K= 0.200 1/SEC KLmf/Uo= 1.215

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	2.226	2.226	0.984	1.053	1.038	-0.038
2	2.494	4.720	0.967	0.996	0.990	0.010
3	2.794	7.514	0.948	0.945	0.946	0.054
4	3.130	10.644	0.927	0.896	0.903	0.097
5	3.506	14.150	0.904	0.849	0.861	0.139
6	3.928	18.077	0.879	0.802	0.819	0.181
7	4.400	22.477	0.853	0.755	0.776	0.224
8	4.929	27.406	0.826	0.707	0.733	0.267
9	5.522	32.928	0.797	0.660	0.690	0.310
10	6.185	39.113	0.767	0.613	0.646	0.354
11	6.929	46.042	0.735	0.566	0.603	0.397
12	7.762	53.804	0.703	0.519	0.559	0.441
13	8.696	62.500	0.669	0.474	0.516	0.484
14	9.741	72.241	0.635	0.429	0.474	0.526
15	10.912	83.154	0.600	0.386	0.433	0.567
16	12.225	95.378	0.566	0.346	0.394	0.606
17	13.694	109.073	0.531	0.307	0.356	0.644
18	15.341	124.414	0.496	0.271	0.320	0.680
19	17.186	141.599	0.462	0.237	0.286	0.714
20	19.252	160.851	0.429	0.206	0.255	0.745
21	5.459	166.310	0.414	0.344	0.360	0.640

APPENDIX D-5

COMPUTER OUTPUT BASED ON KATO-WEN MODEL (MASSIMILLA)

UO= 3.40 CM/S K= 0.045 1/SEC KLmf/Uo= 0.761

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.038	0.038	1.000	0.996	0.996	0.004
2	0.051	0.089	0.999	0.995	0.995	0.005
3	0.068	0.157	0.998	0.992	0.993	0.007
4	0.090	0.247	0.997	0.989	0.990	0.010
5	0.120	0.367	0.995	0.985	0.986	0.014
6	0.160	0.527	0.993	0.980	0.981	0.019
7	0.212	0.739	0.991	0.973	0.974	0.026
8	0.282	1.021	0.987	0.964	0.965	0.035
9	0.375	1.396	0.983	0.952	0.953	0.047
10	0.499	1.895	0.977	0.937	0.938	0.062
11	0.663	2.558	0.970	0.917	0.919	0.081
12	0.882	3.439	0.960	0.891	0.894	0.106
13	1.172	4.611	0.947	0.859	0.863	0.137
14	1.559	6.170	0.931	0.820	0.825	0.175
15	2.072	8.242	0.911	0.772	0.778	0.222
16	2.756	10.998	0.886	0.715	0.722	0.278
17	3.664	14.662	0.856	0.649	0.658	0.342
18	4.872	19.535	0.821	0.576	0.587	0.413
19	6.479	26.013	0.781	0.499	0.511	0.489
20	8.614	34.628	0.735	0.420	0.433	0.567
21	11.454	46.082	0.686	0.343	0.358	0.642
22	14.604	60.686	0.635	0.279	0.295	0.705

UO= 5.20 CM/S K= 0.045 1/SEC KLmf/Uo= 0.497

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.109	0.109	0.999	0.992	0.992	0.008
2	0.169	0.278	0.998	0.987	0.987	0.013
3	0.262	0.540	0.996	0.979	0.980	0.020
4	0.407	0.946	0.993	0.966	0.968	0.032
5	0.631	1.578	0.988	0.948	0.950	0.050
6	0.980	2.558	0.980	0.920	0.924	0.076
7	1.522	4.080	0.970	0.880	0.885	0.115
8	2.363	6.443	0.954	0.823	0.831	0.169
9	3.668	10.110	0.932	0.748	0.758	0.242
10	5.694	15.804	0.901	0.652	0.666	0.334
11	8.840	24.644	0.863	0.541	0.559	0.441
12	13.723	38.367	0.816	0.424	0.446	0.554
13	21.303	59.670	0.761	0.313	0.338	0.662
14	1.818	61.488	0.752	0.670	0.675	0.325

UO= 7.90 CM/S K= 0.045 1/SEC KLmf/Uo= 0.327

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.312	0.312	0.998	0.982	0.984	0.016

2	0.617	0.929	0.995	0.964	0.966	0.034
3	1.222	2.151	0.989	0.930	0.934	0.066
4	2.419	4.570	0.978	0.868	0.875	0.125
5	4.789	9.360	0.959	0.765	0.779	0.221
6	9.482	18.842	0.928	0.618	0.640	0.360
7	18.772	37.614	0.884	0.443	0.475	0.525
8	24.812	62.426	0.837	0.362	0.395	0.605

U0= 10.00 CM/S K= 0.045 1/SEC KLmf/Uo= 0.259

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.589	0.589	0.998	0.971	0.974	0.026
2	1.428	2.017	0.992	0.931	0.936	0.064
3	3.464	5.481	0.980	0.844	0.855	0.145
4	8.404	13.885	0.956	0.688	0.709	0.291
5	20.387	34.271	0.917	0.470	0.506	0.494
6	28.761	63.033	0.873	0.373	0.413	0.587

U0= 14.30 CM/S K= 0.045 1/SEC KLmf/Uo= 0.181

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	1.784	1.784	0.995	0.932	0.938	0.062
2	7.031	8.815	0.980	0.771	0.791	0.209
3	27.706	36.521	0.944	0.457	0.503	0.497
4	27.561	64.082	0.910	0.441	0.486	0.514

APPENDIX D-6

COMPUTER OUTPUT BASED ON KATO-WEN MODEL (LEWIS)

UO= 4.80 CM/S K= 0.930 1/SEC KLmf/Uo= 8.137

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.081	0.081	0.987	0.935	0.940	0.060
2	0.093	0.174	0.972	0.914	0.920	0.080
3	0.107	0.281	0.955	0.890	0.897	0.103
4	0.122	0.403	0.937	0.864	0.872	0.128
5	0.140	0.543	0.917	0.836	0.844	0.156
6	0.160	0.704	0.894	0.805	0.814	0.186
7	0.184	0.888	0.870	0.771	0.782	0.218
8	0.211	1.098	0.843	0.735	0.746	0.254
9	0.241	1.339	0.813	0.696	0.709	0.291
10	0.276	1.616	0.782	0.655	0.669	0.331
11	0.316	1.932	0.748	0.612	0.627	0.373
12	0.363	2.294	0.712	0.568	0.583	0.417
13	0.415	2.710	0.674	0.522	0.538	0.462
14	0.476	3.185	0.635	0.476	0.493	0.507
15	0.545	3.730	0.594	0.429	0.447	0.553
16	0.624	4.355	0.552	0.384	0.401	0.599
17	0.715	5.070	0.510	0.339	0.357	0.643
18	0.819	5.889	0.468	0.296	0.314	0.686
19	0.938	6.827	0.426	0.256	0.274	0.726
20	1.075	7.902	0.385	0.218	0.236	0.764
21	1.231	9.134	0.345	0.184	0.201	0.799
22	1.411	10.544	0.307	0.153	0.170	0.830
23	1.616	12.160	0.271	0.126	0.142	0.858
24	1.851	14.012	0.238	0.103	0.117	0.883
25	2.121	16.132	0.207	0.083	0.096	0.904
26	2.429	18.562	0.179	0.066	0.078	0.922
27	2.783	21.344	0.154	0.052	0.062	0.938
28	3.188	24.532	0.131	0.040	0.050	0.950
29	3.652	28.184	0.111	0.031	0.039	0.961
30	4.183	32.367	0.094	0.024	0.031	0.969
31	4.792	37.160	0.079	0.018	0.024	0.976
32	5.490	42.649	0.066	0.013	0.019	0.981
33	4.303	46.952	0.055	0.014	0.018	0.982

UO= 9.30 CM/S K= 0.930 1/SEC KLmf/Uo= 4.200

I	SIZE	HEIGHT	CB/CO	CE/CO	C/CO	CONVERSION
1	0.350	0.350	0.975	0.832	0.853	0.147
2	0.456	0.806	0.945	0.772	0.797	0.203
3	0.594	1.399	0.909	0.703	0.732	0.268
4	0.773	2.173	0.867	0.627	0.661	0.339
5	1.007	3.180	0.819	0.546	0.585	0.415
6	1.312	4.492	0.767	0.464	0.507	0.493
7	1.709	6.202	0.710	0.383	0.430	0.570
8	2.227	8.428	0.650	0.308	0.357	0.643
9	2.901	11.329	0.590	0.241	0.291	0.709

10	3.778	15.107	0.529	0.183	0.233	0.767
11	4.922	20.029	0.471	0.136	0.184	0.816
12	6.412	26.441	0.416	0.099	0.144	0.856
13	8.352	34.793	0.364	0.070	0.112	0.888
14	10.879	45.672	0.317	0.049	0.087	0.913
15	3.355	49.027	0.286	0.107	0.132	0.868

U0= 15.30 CM/S K= 0.930 1/SEC KLmf/Uo= 2.553

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	1.078	1.078	0.963	0.680	0.729	0.271
2	1.673	2.751	0.916	0.555	0.619	0.381
3	2.596	5.346	0.860	0.427	0.503	0.497
4	4.028	9.374	0.796	0.309	0.395	0.605
5	6.250	15.624	0.729	0.211	0.302	0.698
6	9.699	25.323	0.660	0.137	0.229	0.771
7	15.050	40.373	0.593	0.086	0.175	0.825
8	10.602	50.975	0.537	0.104	0.180	0.820

U0= 19.30 CM/S K= 0.930 1/SEC KLmf/Uo= 2.024

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	1.864	1.864	0.957	0.581	0.653	0.347
2	3.263	5.127	0.903	0.422	0.514	0.486
3	5.711	10.838	0.840	0.279	0.387	0.613
4	9.994	20.832	0.771	0.171	0.286	0.714
5	17.491	38.323	0.702	0.098	0.214	0.786
6	13.685	52.008	0.642	0.110	0.212	0.788

U0= 26.00 CM/S K= 0.930 1/SEC KLmf/Uo= 1.502

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	3.923	3.923	0.951	0.433	0.544	0.456
2	8.481	12.403	0.891	0.247	0.385	0.615
3	18.333	30.736	0.825	0.124	0.274	0.726
4	22.713	53.449	0.761	0.095	0.238	0.762

U0= 35.00 CM/S K= 0.930 1/SEC KLmf/Uo= 1.116

I	SIZE	HEIGHT	CB/C0	CE/C0	C/C0	CONVERSION
1	8.953	8.953	0.948	0.278	0.436	0.564
2	26.480	35.433	0.887	0.108	0.293	0.707
3	19.577	55.010	0.833	0.132	0.298	0.702

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