CORROSION OF ALUMINUM IN CONCRETE

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PREFACE

While aluminum alloys in contact with concrete have been used successfully in many applications there have been cases where aluminum was severely attacked by concrete for reasons unknown.

The experimental work reported in this paper was done to define conditions which will result in rapid corrosion of aluminum in concrete and which could exist in practice. The conditions studied included various admixtures, voids in concrete, and impressed currents.

I wish to express my sincere appreciation to Dr. S. P. Ewing, my major advisor, for his assistance and helpful ideas; to Dr. Franklin Graybill for his aid in statistical analyses; to my advisory committee for their guidance; to the Aluminum Company of America for supplying the aluminum alloy used in the experimental work; and to the Jersey Production Research Company whose financial support made this work possible. Special thanks are due my wife Norma for typing the manuscript as well as her support and encouragement.

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CHAPTER I

INTRODUCTION

Aluminum is widely used in chemical and petroleum industries because of its high resistance to many corrosive environments which are incompatible with most other common metals. This corrosion resistance is shown by the use of aluminum in production of organic acids, transportation of concentrated nitric acid, as well as in ammonia synthesis. It has been used in the petroleum industry in storage tanks and pipelines, in portable drilling platforms, and experimentally as protector casings in offshore locations.

Aluminum alloys may be utilized over a wide pH range as shown by their use with nitric acid and ammonia. However, in many alkaline environments aluminum will be severely corroded as a result of the increased solubility of its natural oxide film. Therefore, the resistance of aluminum to alkaline conditions is dependent on the formation and maintenance of protective films of insoluble corrosion products other than aluminum oxide. Thus aluminum resists attack in calcium and ammonium hydroxides by growth of insoluble aluminate films.

In many applications, aluminum is in contact with, or imbedded in, concrete which is highly alkaline. This is evidenced by aluminum window frames, bridge railings, walkways, and conduits. In oil production operations, aluminum is in contact with concrete in drilling platforms and in the experimental casing protectors; offshore aluminum pipelines are also often anchored by concrete weights at intervals along the line.

While aluminum has been shown to be compatible with concrete with little need for protective coatings, there have been cases (4,13) where aluminum was severely corroded in concrete for reasons then unknown. Therefore it was considered desirable to carry out an experimental investigation to define conditions in which aluminum would be incompatible with concrete. Once these conditions are known, conditions may be defined under which aluminum alloys could be used in association with concrete.

Limitations of Study

Concrete admixtures used in these tests were limited to additions of calcium chloride and sodium hydroxide in various ratios. Calcium chloride is often added to concrete to increase the setting rate and reduce susceptibility to freezing in cold weather. While sodium hydroxide is not a constituent nor an additive of concrete its use should give concretes with maximum corrosiveness. Sodium hydroxide and calcium chloride react, when added in equal chemical equivalents, to give solutions of sodium chloride. Sodium chloride may well occur in concrete mixtures as a result of its almost universal occurrence in natural waters. Addition of non-equivalent amounts of these chemicals changes the pH, the direction of change depending on the chemical in excess.

The three types of environmental conditions tested were:

1. Static corrosion tests of aluminum alloy imbedded in concrete.

2. Electrolytic anodic and cathodic tests of aluminum alloy imbedded in concrete

3. Galvanic type cells to determine what effect, if any, voids in concrete have on the corrosion rates of aluminum in concrete.

These various tests were intended to provide information on corrosion for any condition which is likely to occur in practice. There were no attempts made to evaluate inhibitors, or protective coatings in any of these tests.

CHAPTER II

LITERATURE REVIEW

The references briefly reviewed in this chapter are concerned with the corrosion of aluminum and its alloys in concrete or are considered to have an important bearing on this subject.

The high corrosion resistance of aluminum to many aggressive environments is attributed to the nearly invisible inert oxide film which forms on aluminum when exposed to the atmosphere. This resistant film is strengthened by additional hydrated alumina formed when the alloy is placed in nearly neutral solutions (9). Examination of the solubility curves for various forms of aluminum oxides with pH indicates the natural oxide film loses its protective nature above a pH of 9 as a result of increasing solubility (1,4). Deltombe and Pourbaix (4) have shown from a thermodynamic standpoint that above a pH of 8.5 the normal oxide film is not protective because of increasing solubility. The presence of certain ions such as silicates or chromates inhibits the corrosion process. Calcium and ammonium ions cause the formation of insoluble aluminate films.

McKee and Brown (9) determined corrosion rates for aluminum in ammonium and sodium hydroxide solutions of varying concentrations. The corrosion rate in sodium hydroxide increased rapidly with increase in concentration. Rates exceeded 1000 mils per year in tenth normal sodium hydroxide solutions. Additions of chloride, sulphate, nitrate and acetate ions did not affect corrosion rates; in one normal chromate solution the corrosion was markedly reduced. Contrasted with the extremely high rates in sodium hydroxide were the low rates observed in ammonium hydroxide which showed a maximum of 10 mils per year in a 5 normal solution. These variations in corrosion rates were attributed to the differences in solubility of the corrosion products in sodium and ammonium hydroxides.

Aluminum is also subject to cathodic corrosion. Mears and Brown (10) found that the corrosion rate of cathodically protected aluminum in aluminum chloride solution increased when the current density exceeded the value required for protection. Caldwell and Albano (3) found cathodic polarization of aluminum in sodium sulphate solutions stimulated corrosion. Rotation of the electrode reduced the corrosion somewhat; however, rates were still higher than for uncoupled electrodes. In moderate-to-strong sodium hydroxide there was little effect of impressed cathodic current on corrosion rates of aluminum. The increased corrosion was attributed to unbalanced hydroxyl ion resulting from hydrogen evolution in the aluminum chloride and production of caustic in the sodium sulphate.

Cured concrete, which always contains calcium hydroxide, has a pH 12-13. For this reason, corrosion of aluminum might be expected when in contact with concrete. Walton, McCreary, and Ingle (13) have shown corrosion rates of aluminum in concrete are high initially, but the attack is self-stifling with the formation of highly protective calcium aluminate films. The film formed on 3003 aluminum alloy exposed to calcium hydroxide was $3\ CaO \cdot Al_2O_3 \cdot 8\text{-}12\ H_2O$; in a Portland cement slurry, $Al_2O_3 \cdot 6\ CaO \cdot 3\ SO_3 \cdot 32\ H_2O$. Addition of calcium chloride or sodium chloride had very little effect on the corrosivity of concrete to aluminum in the absence of galvanic couples. Curing the concrete under continously wet, cyclically wet or dry conditions did not appreciably influence corrosion of the aluminum alloy.

Galvanic couples with mild steel cathodes were studied using aluminum to mild steel area ratios from 1:1 to 1:12 in plain concrete and in a sodium chloride admixture. (13). In chloride free concrete, coupled samples showed less corrosion than the uncoupled control samples. Sodium chloride accelerated corrosion somewhat with localized attack. Corrosion was low in all cases with a maximum of 2.43×10^{-3} $\text{inches}^3/\text{inches}^2$ when a 3 1/2 percent by weight sodium chloride solution was used as mix water. The maximum pit depth was 21.7 mils.

This work corroborated experiments by Wright, Godard, and Jenks (14). They reported corrosion of aluminum in concrete was nearly stifled after eight days and the appearance of specimens after six months, one, and two years exposure was very similar. Attack was a general etch with a maximum thickness loss after one year of 4.4 mils per side. Corrosion rates were found to be independent of brand of cement but did increase with increased richness of mix.

Tronstad and Veimo (11) conducted a series of tests to determine the effect of various cements on the corrosion of aluminum. They found aluminum was corroded by concrete but the attack was not overly severe. Fischer and Vosskuhler (7) found in detailed long term studies that "unprotected aluminum alloys are sufficiently resistant to mortar material but, nevertheless, some protection should be applied".

These experimental results indicate little need for coating or other protective measures when using aluminum with concrete. However, there is a reported case of very severe corrosion of aluminum conduit imbedded in concrete between floors of a hospital. After extensive investigation it was concluded that the corrosion was a result of excessive additions of calcium chloride to the concrete and either galvanic corrosion between the steel reinforcing and aluminum conduits or from stray currents induced by arc welders during construction of the hospital (15).

Another case of very severe pitting is known where the annular space of a four inch IPS alclad (inside) 6061-T6 pipe, containing a 1 3/8-inch IPS steel pipe insulated from the aluminum, was filled with an unknown concrete mixture (5). The grout was pumped into the annulus while the pipe was in a horizontal position. As a consequence there was a longitudinal void extending the length of the pipe leaving approximately two inches of the inside circumference free of concrete. On examination of the pipe after five months vertical exposure in slightly saline water, severe pitting and perforation from the inside at several points along the void was noted.

The admixtures added to the concrete mixture apparently were not the ones which had been specified for the test. Therefore, the test was not a fair test of aluminum in this type of service. However, it was thought that an investigation might provide a clue to the conditions to be avoided when using aluminum in contact with concrete. Samples of the concrete were crushed and leached with water. The leachings were analyzed for cations and were found to contain iron, aluminum, calcium, sodium and potassium. The pH of the solution was 12.7. There was little or no chloride ion present. Sodium and potassium concentrations were higher than would be expected from the supposed concrete mix used. There was nothing from these results to indicate the cause of the extreme pitting noted.

CHAPTER III

MATERIALS AND PROCEDURE

Materials

The concrete used in the corrosion tests was a 1:2:0 ratio by weight Atlas Type I Portland cement (approximate analysis in Appendix B) and washed, screened, and dried sand passing an 8 mesh Tyler standard screen. Distilled water was used for mixing. All additives to the concrete were added in the mix water from standardized solutions.

The 6061-T6 and 5154-H34 aluminum alloys tested were supplied by the Aluminum Company of America. (Nominal compositions are given in Appendix B). The 5154 alloy cups were drawn by the Alcoa Research Laboratory using annealed (-O) sheet. The 6061 cups were drawn in the -T4 temper then immediately artificially aged to the -T6 temper.

Preparation of Test Specimens

The aluminum coupons for all tests were cut to the desired size, holes drilled where necessary, and scribed with an identifying number. The specimens were then washed with soap and water, scoured with cleanser, rinsed, and etched for ten minutes in a 2 percent chromic acid, 5 percent phosphoric acid solution at 170-190°F., (12) rinsed with distilled water, dipped in acetone, dried, weighed, and stored in a desiccator. Coatings and electrical connections were made after weighing.

Coatings were either Ucilon corrosion-resistant coating or Armstrong C-7 epoxy plastic. Re-exposed surfaces were swabbed with acetone after handling.

Ucilon coatings were readily removed by washing in acetone. Armstrong C-7 plastic was softened by soaking in methyl ethyl ketone and then stripped with a lucite scraper. Corrosion products were removed by treatment with the hot phosphoric-chromic acid mixture for ten minutes. The coupons were then rinsed, dried, and weighed. Severe corrosion necessitated longer cleaning periods to remove the corrosion products.

Aqueous Corrosion Tests

Since corrosion of metals is affected by the presence of certain ions in the corrosion medium, exploratory work was carried out to determine specific ion effects on 6061-T6 and 5154-H34 aluminum alloys in calcium, sodium, and ammonium hydroxides. The three alkaline solutions were selected to determine the relative effects of the respective cations on the corrosion of aluminum by a base. To eliminate pH effect among solutions, each was adjusted to the measured pH of saturated calcium hydroxide.

Anionic effects for chloride and carbonate were determined by additions of ammonium chloride, ammonium carbonate, and sodium carbonate to each of the three basic alkaline solutions to make the solution 0.1 normal in the anion. The solutions used are given in Table I.

Wide-mouth, rubber-stoppered, 500-cubic centimeter glass bottles filled with 450 milliliters of solution were used for the aqueous corrosion tests. Four coupons, 2 inches by 0.5 inches with a 3/16-inch hole drilled at one end, cut from 0.064 inch sheet, were suspended in each bottle from glass hooks. A center hole was drilled through the stopper to permit hydrogen evolved in the corrosion process to escape. The cells were then placed in a constant temperature bath at 75°F. After one week, two coupons were removed from each bottle ; the remaining coupons were removed after two weeks exposure.

In this and all the following described test methods, no effort was made to exclude oxygen. Bryan and Morris (2) found that corrosion rates of pure and impure aluminum were not appreciably different in oxygen-free, and in oxygen-saturated, buffered alkaline solutions.

Preliminary corrosion tests in cement slurries confirmed these results.

TABLE I

SOLUTIONS USED IN AQUEOUS CORROSION TESTS

Solution		pH
Sat. $Ca(OH)_2$		12.8
Sat. $Ca(OH)_2$	-0.1 N NH_4Cl	12.6
Sat. $Ca(OH)_2$	-0.1 N $(NH_4)_2CO_3$	12.8
Sat. $Ca(OH)_2$	-0.1 N Na_2CO_3	12.8
NaOH		12.8
NaOH	-0.1 N NH_4Cl	12.1
NaOH	-0.1 N $(NH_4)_2CO_3$	12.3
NaOH	-0.1 N Na_2CO_3	13.0
NH_4OH		12.7
NH_4OH	-0.1 N NH_4Cl	12.1
NH_4OH	-0.1 N $(NH_4)_2CO_3$	12.3
NH_4OH	-0.1 N Na_2CO_3	12.3

Static Corrosion Tests in Concrete

Corrosion-time curves for 6061-T6 aluminum alloy were determined for twelve different concrete admixtures. The concrete was a 1:2:0 mix by weight with 750 milliliters distilled water, made to the desired concentration of calcium chloride and/or sodium hydroxide, per 1000 grams cement. These solutions are given in Table II. The concrete was hand mixed in batches sufficient to fill four cells. Each mix was replicated once, making a total of eight cells for the mix.

TABLE II

SOLUTIONS USED IN CONCRETE MIXTURES

Mix No.	Solution
1	Distilled water
2	0.01 N NaOH
3	0.05 N NaOH
4	0.10 N NaOH
5	0.01 N $CaCl_2$
6	0.10 N $CaCl_2$
7	1.0 N $CaCl_2$
8	0.01 N $CaCl_2$-0.01 N NaOH
9	0.10 N $CaCl_2$-0.01 N NaOH
10	0.10 N $CaCl_2$-0.10 N NaOH
11	1.0 N $CaCl_2$-0.05 N NaOH
12	1.0 N $CaCl_2$-0.10 N NaOH

The test cells consisted of square one pint polyethylene containers filled with concrete to within one-half inch of the top. Two 2-inch square aluminum alloy coupons cut from 0.032 inch sheet were placed in each cell approximately 20 minutes after mixing. A water cap was maintained over each cell throughout the exposure period.

After exposure, at room temperature, for 3, 6, 12, and 24 days replicate cells were broken open, the coupons cleaned and weighed. Volume losses were then calculated from weight loss data.

Galvanic Cells

Four experiments designed to test the effect of voids in concrete on corrosion of 6061-T6 and 5154-H34 alloys were carried out. The first two experiments tested both alloys with an exposed area of approximately two square inches on the center strip, using the twelve mixes given in Table II. The only modification in the mixes was increased water-cement ratio of 3000 grams solution per 1000 grams cement. In the latter two experiments mixes 1, 2, 3, 6, 8, and 10 were used with areas of the center strip of 0.75 and 1.5 square inches. Each treatment was duplicated once.

Galvanic corrosion cells consisted of 4-inch diameter by 3-inch deep aluminum alloy cups drawn from 0.064 inch sheet. (Figure 1). The outside and upper half of the cups were coated with Ucilon. Sufficient concrete was added to cover the exposed aluminum; the cup was then filled with excess water from the concrete mix. Center strips for the cells were cut from 0.040 inch aluminum sheet in one-half inch strips varying from nine to twelve inches in length and bent into a chair-shaped rectangular loop with the ends of the strip forming the back of the chair. This loop was coated with Ucilon and taped with plastic tape except for a specific area of the loop which was exposed. The strip was held in a lucite cap, machined to fit the aluminum cup, by means of a split No. 2 rubber stopper and so positioned that the exposed aluminum was in the water phase.

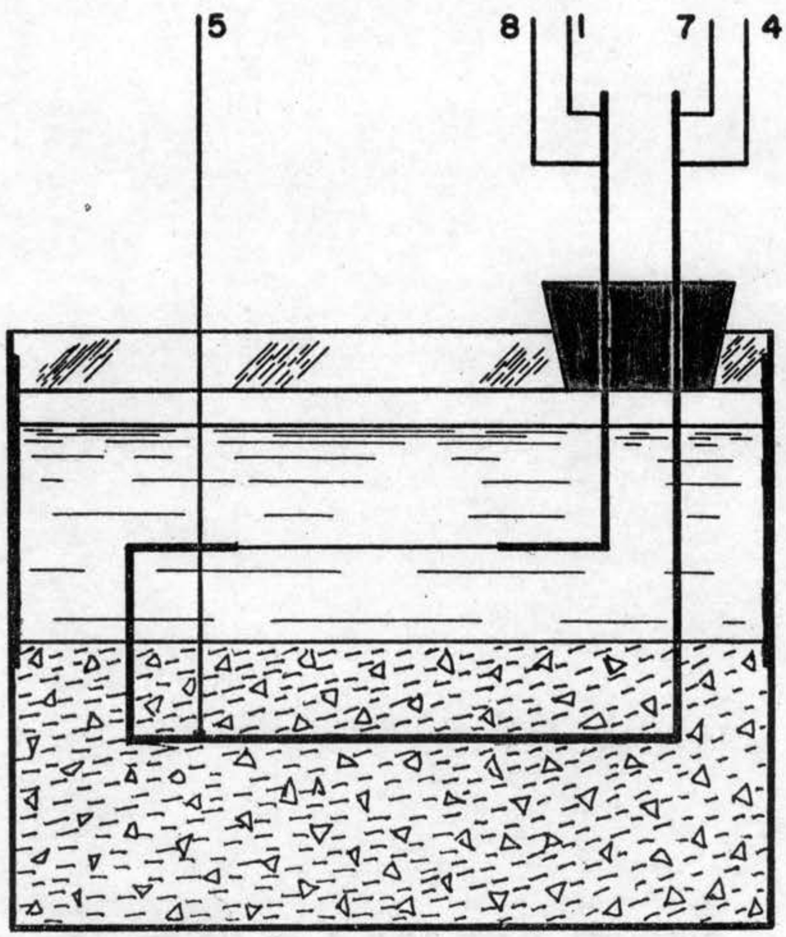

FIGURE I— Galvanic Cell

Electrical contact was made with each end and the center of the strip for measuring the resistance change in the strip. The strip was also electrically bonded through a five ohm resistor to the cup.

The potential differences across the five ohm resistors were measured by a Leeds and Northrup No. 8662 precision potentiometer connected to the resistors through a selector switch. The current flow and the polarity of the cells were then determined.

Resistance changes of the aluminum strips were measured by a Wheatstone bridge arrangement consisting of the aluminum test strip, potentiometer, a decade resistance box, and a galvanometer. (Figure 2).

To this end two lead wires were soldered, one-half inch apart, to each end of the strip and a single lead to the center. These, in turn, were connected to a Cannon GK-58-31SL cable connector. The remainder of the circuit was composed of a Leeds and Northrup Model K potentiometer and a decade resistance box. The potentiometer was connected from the C pole to the terminal of a Cannon GK-58-22C-5/8 cable connector corresponding to the lead from the exposed end of the strip. The BA terminal was connected to the decade resistance box and thence through the cable connector to the coated end of the strip. The galvanometer circuit in the bridge utilized a Leeds and Northrup No. 2420-B galvanometer and microswitch connected from the center of the aluminum strip to the galvanometer contact of the potentiometer. Power was supplied to the bridge circuit from a six volt storage battery through a variable resistor and ammeter to the end contacts on the aluminum strip.

The complete experimental set-up is shown in Plate I.

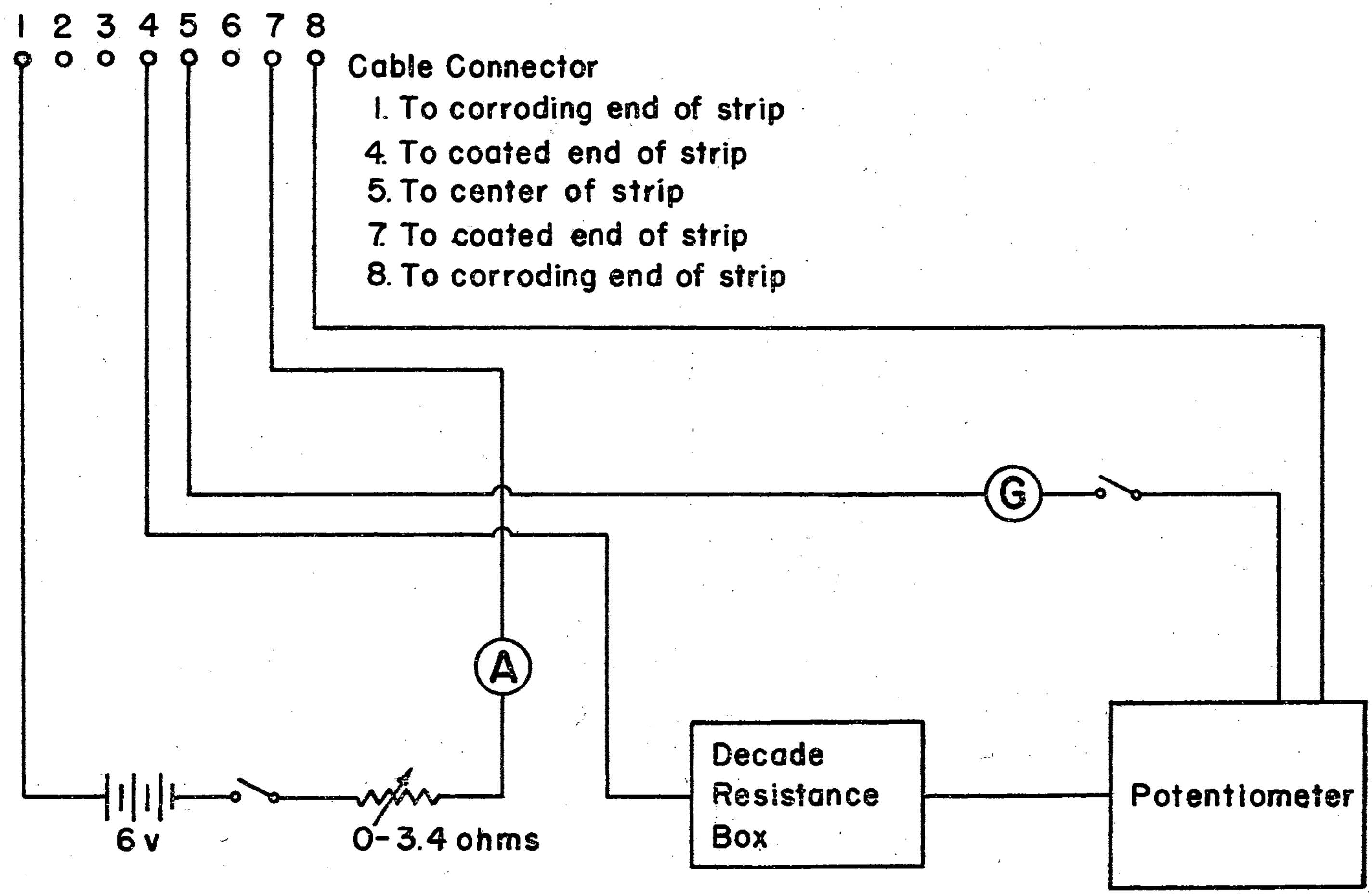

FIGURE 2— Resistance Measuring Circuit

PLATE I

GALVANIC CELLS

The concrete was hand-mixed in 2000 milliliter beakers, one batch to each cell with one replicate of each mix. The slurries were agitated twice at fifteen minute intervals and allowed to settle. Excess water was decanted from the concrete which was then poured into the corrosion cell until the exposed area of the cup was covered. The cell was filled with the decanted water and the lucite cap placed on the cell positioning the center strip. The leads from the strip and cup were soldered into the resistance- and current-measuring circuits and the cups placed in a constant temperature bath at 75°F.

Resistance readings were made by impressing approximately 20 amperes through the aluminum strip and adjusting the slide wire and decade box until there was no deflection of the galvanometer when the circuit was closed. Changes in thickness were calculated by (derivation is given in Appendix A)

$$\Delta t = t_o \left[1 - \frac{L'}{L_e\left(\frac{80.2 + 5r}{R_d + 5.5 - 5r} - \frac{L - L'}{L_e}\right)} \right]$$

where: Δt = thickness loss

t_o = initial thickness of strip

L' = length of strip exposed to corrosion

L = length of corroding end of strip

L_e = calculated length of coated half of strip

r = slidewire reading

R_d = resistance of decade box

L_e is calculated from the initial reading when $\Delta t = 0$.

Current flow was calculated after periodically measuring the potential drop across the 5-ohm resistors.

The cells were removed after twenty-four days, and the cups and strips cleaned and weighed. The volume losses were subsequently calculated.

Electrolytic Cells

The effect of impressed current on corrosion of 6061-T6 alloy was tested in electrolytic corrosion cells, utilizing solutions 1, 6, and 10 of Table II.

Square one-pint polyethylene containers were filled with concrete to one-half inch of the top of the container. The aluminum electrodes, positioned at opposite sides of the cell facing each other, were cut from 0.040-inch 6061-T6 aluminum alloy in 1.5 x 1.5, 2.5 x 1.5, and 2.5 x 3.0 inch rectangles. An insulated copper wire was soldered to the back of each coupon using Sal-Met flux. The back and edges of the coupons were coated with Ucilon and Armstrong C-7 plastic exposing one-, two-, and five-square inch areas to corrosion. A constant direct current of 1 milliampere supplied from a Krohn-Hite Model UHR-220 power supply through a 50,000 ohm resistor, was impressed across the cells which were connected in series. A 5/8-inch diameter by 2-inch glass tube was placed in the center of the cell to accomodate the saturated calomel electrode used to measure the potential drop across the aluminum concrete interface. (Figure 3).

Potential measurements between the half cell and each electrode, and across the cell were made with a Southwestern Industrial Electronics Company Model R-1 high resistance voltmeter. Current to the cells was measured with a Weston Model One millivoltmeter. Plate II shows the equipment and cells used in this test.

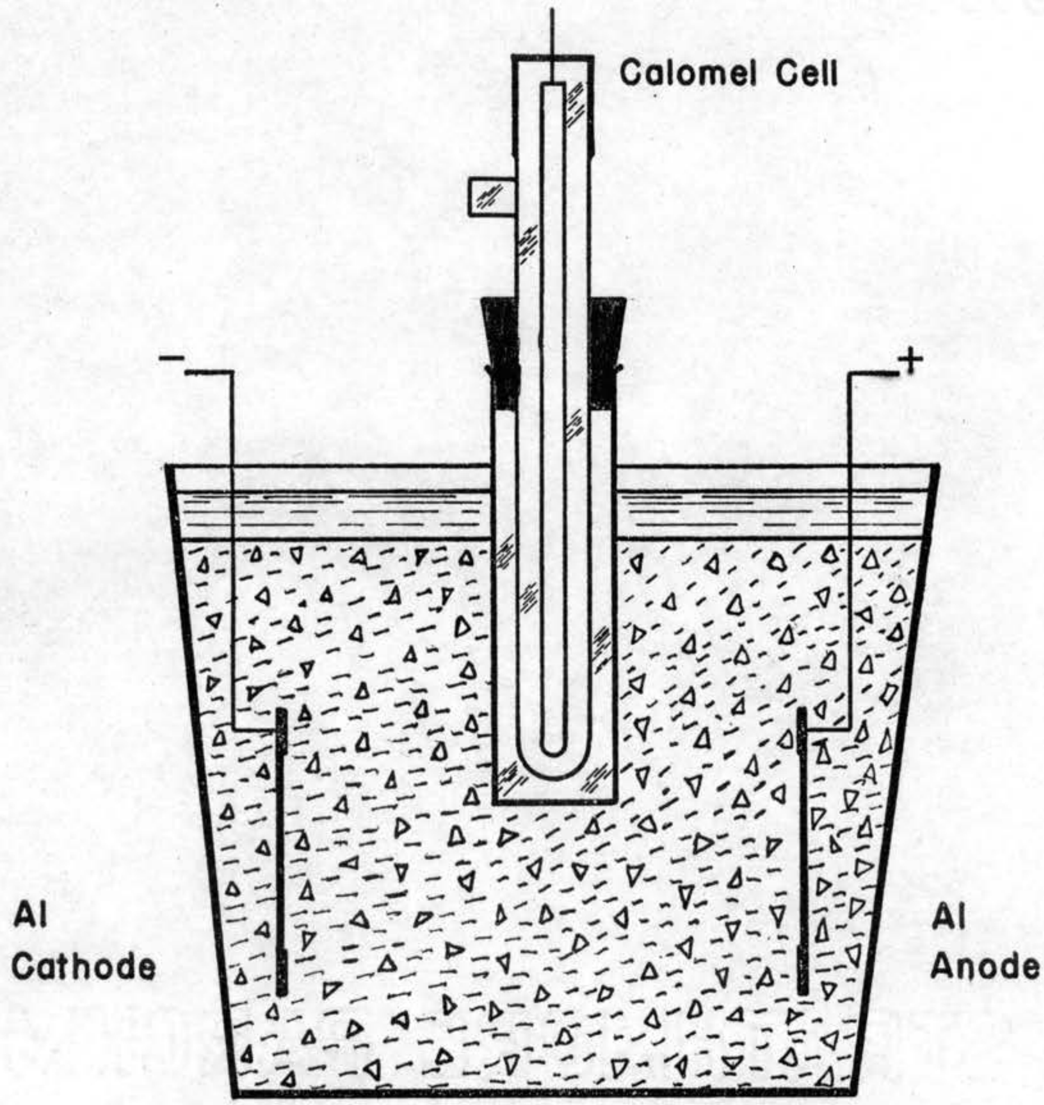

FIGURE 3— Electrolytic Cell

PLATE II

ELECTROLYTIC CELLS

The concrete mix was hand-mixed in batches sufficient to fill three cells. The water-cement ratio was 750 grams of water per 1000 grams cement. Equal anode areas were used within each cell. The three sizes of coupons were used with each batch.

The electrodes were placed in the cells 20 minutes after mixing the concrete and the current was immediately applied. Current was controlled by varying the 50,000 ohm resistor and the applied voltage. The voltage drop across each cell and the potential of each electrode with respect to a saturated calomel half cell were measured immediately and at intervals throughout the exposure period.

Cells were broken open after exposure of 3, 6, and 12 days with all cells from one concrete batch being removed at the same time; thus differences among replicate batches are included with differences with time.

After removal from the cells the lead wires were removed from the coupons which were then immersed in methyl ethyl ketone for several hours to soften the plastic coating. The coupons were cleaned and weighed.

Statistical Analysis

All corrosion tests using the various concrete mixtures were designed so analysis of variance could be performed on the data for estimation of the error mean square for each experiment. The Standard Error of the Mean and Least Significant Difference for each treatment mean were computed at the 95% level using the error mean square and "Student's" t. Once the Least Significant Difference was estimated the mean volume loss for each treatment could be compared with the volume loss for any other treatment in the same analysis. If the difference between the means is greater than the Least Significant Difference there is a 95% probability the means differ.

The treatment design for the electrolytic test was a 3^3 factorial of time, current density and mix without replication of individual treatments. Therefore, there was no direct estimate of experimental error. However, with the assumption of negligible three factor interaction the error mean square for this interaction is an estimate of the discrepance. (6). Each treatment in the static corrosion and galvanic tests was replicated so the error mean square could be estimated directly. Two analyses of the volume loss data for the cups and for the strips were required; one analysis tested the effect of alloy and concrete mix for all twelve mixes; the other tested the effect of alloy, area, and mix for three areas and six mixes.

CHAPTER IV

RESULTS

Aqueous Corrosion Tests

The results given in Tables III and IV show the very marked dependence of corrosion rates on the cations present in solution as well as the alloy being tested. The type and severity of attack are shown to differ between the two alloys.

The 5154-H34 test specimens were severely pitted in the more aggressive solutions; attack was limited to the rolling grain of the alloy when exposed to moderately aggressive environments. In the less corrosive media, attack was a mild overall etch leaving a satin finish on the coupon. The attack on 6061-T6 alloy by sodium hydroxide solutions was more severe with preferential attack on the central areas of the coupons. The edges of the coupons resisted attack. The result, after seven days exposure, was a paneled effect with the central areas of the strip severely but uniformly corroded. After fourteen days, only the edges of the coupon remained, leaving a "picture-frame". In sodium hydroxide-ammonium chloride solution, the coupons were severely pitted with no appreciable decrease in thickness. The remaining coupons were uniformly attacked with some pitting along the grain of the alloy. Again in the less corrosive solutions the attack was a very mild etching action. Differences in attack are shown by Plate III.

PLATE III

EFFECT OF CALCIUM, AMMONIUM, AND SODIUM IONS ON CORROSION OF ALUMINUM

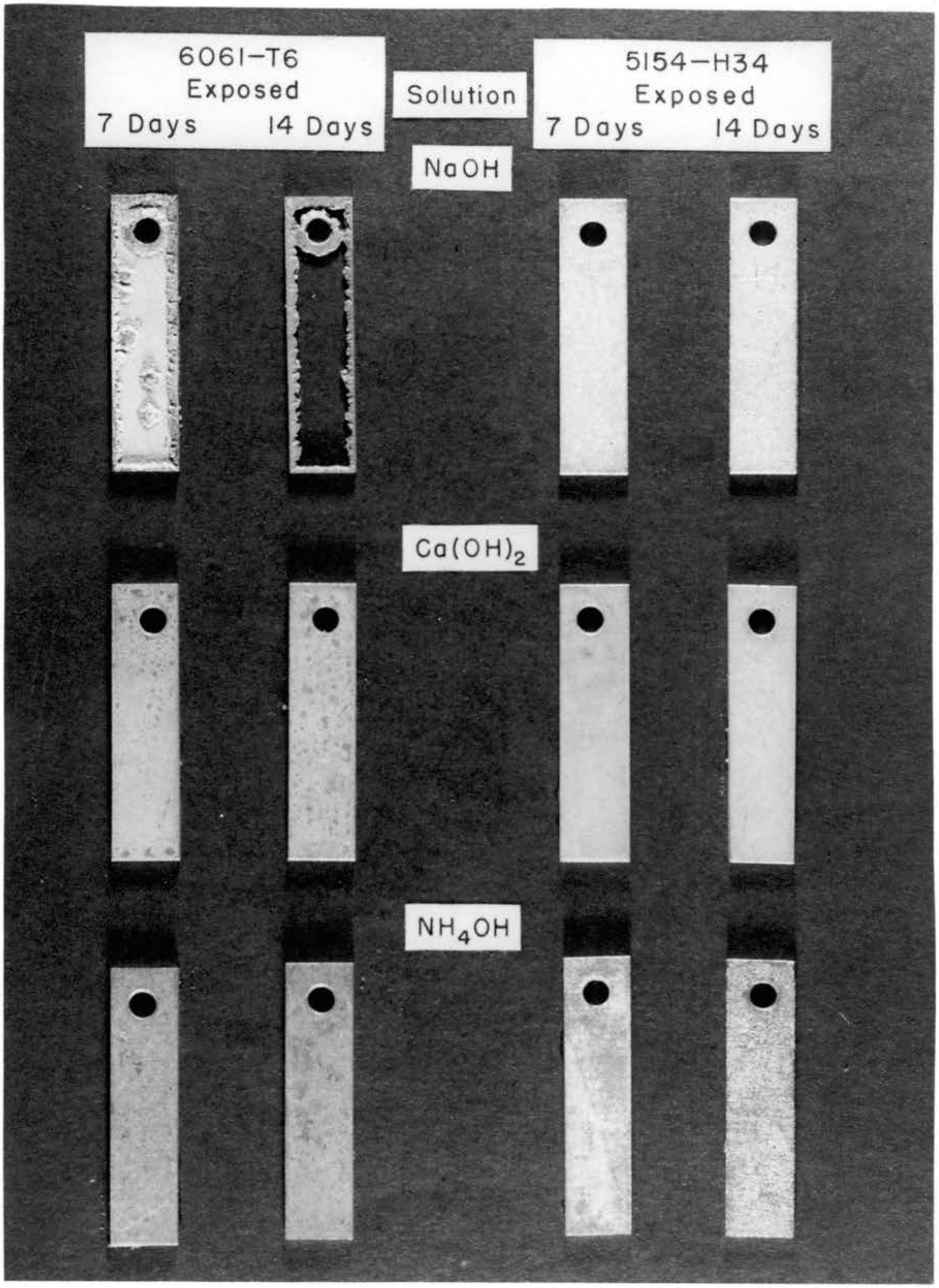

TABLE III

EFFECT OF VARIOUS CATIONS AND ANIONS ON CORROSION OF 5154-H34 ALLOY

Solution	pH	Volume Loss ($in^3/in^2 \times 10^3$) Exposed 7 days	14 days	Type of Corrosion
NaOH -0.1 N Na_2CO_3	13.0	2.534	2.889	Pitted
NaOH	12.8	2.400	2.766	Pitted
$Ca(OH)_2$-0.1 N Na_2CO_3	12.8	2.218	2.620	Discrete areas severely attacked
NaOH -0.1 N NH_4Cl	12.1	1.025	1.625	Numerous small pits
NH_4OH -0.1 N Na_2CO_3	12.8	0.951	0.988	Overall attack, pitting with grain
NaOH -0.1 N $(NH_4)_2CO_3$	12.3	0.860	0.967	Overall attack, pitted with grain
NH_4OH	12.7	0.691	1.553	Attack along rolling grain
$Ca(OH)_2$	12.8	0.670	0.803	Overall etch
$Ca(OH)_2$-0.1 N $(NH_4)_2CO_3$	12.8	0.571	0.799	Overall etch
NH_4OH -0.1 N $(NH_4)_2CO_3$	12.3	0.406	0.508	Small area attacked in grain
$Ca(OH)_2$-0.1 N NH_4Cl	12.6	0.134	0.175	Light overall etch
NH_4OH -0.1 N NH_4Cl	12.1	0.027	0.038	No noticeable attack

Static Corrosion Tests in Concrete

Visual examination of the coupons from the static corrosion tests revealed three different types of attack. In distilled water, 0.01 normal sodium hydroxide, 0.01 normal calcium hydroxide - 0.01 normal sodium hydroxide and 0.1 normal calcium chloride admixtures, the coupons suffered a general overall etch with small areas apparently partially protected, lending a mottled appearance to the samples. In 0.05 and 0.1 normal sodium hydroxide and 0.1 normal calcium chloride-sodium hydroxide mixes, the attack was more severe. There was little evidence of protected areas, but some minor pitting was seen. On mixing concrete with a one normal solution of calcium chloride, with or without additions of sodium hydroxide, the surface of the coupons showed very slight attack with many very small pits developing after twelve days exposure.

TABLE IV

EFFECT OF VARIOUS CATIONS AND ANIONS ON CORROSION OF 6061-T6 ALLOY

Solution	pH	Volume Loss ($in^3/in^2 \times 10^3$) Exposed 7 days	14 days	Type of Corrosion
NaOH -0.1 N Na_2CO_3	12.6	19.037	19.360*	Relatively uniform except for edges
NaOH	12.5	18.342	20.457*	Relatively uniform except for edges
$Ca(OH)_2$-0.1 N Na_2CO_3	12.5	5.001	8.178	General attack except where protective film formed
NaOH -0.1 N NH_4Cl	12.2	2.643	3.424	Severe pitting
NH_4OH -0.1 N $(NH_4)_2CO_3$	12.3	1.028	1.382	Attack along grain
NH_4OH	12.6	1.003	1.025	Overall attack, minor pitting
NH_4OH -0.1 N Na_2CO_3	12.8	0.992	1.233	Overall attack, more severe with grain
NaOH -0.1 N $(NH_4)_2CO_3$	11.6	0.691	1.942	Preferential attack with grain
$Ca(OH)_2$-0.1 N $(NH_4)_2CO_3$	12.5	0.596	0.730	Overall attack with a few small unattacked areas
$Ca(OH)_2$	12.5	0.580	0.755	Overall etch
NH_4OH -0.1 N NH_4Cl	11.6	0.311	0.165	Light etch
$Ca(OH)_2$-0.1 N NH_4Cl	12.3	0.143	0.165	Light etch

*Not valid estimate of volume loss as only edges remained after exposure.

The Least Significant Difference obtained from the analysis of variance provided a means of separating the volume losses into five groups. (Analyses of variance are in Tables XV, XVI, XVII, and XVIII in Appendix C.) If the volume loss means for the coupons exposed 24 days are grouped so all differences within each group do not differ significantly, the corrosiveness of the admixtures in decreasing order is: 0.1 normal calcium chloride, 0.1 normal calcium chloride-sodium hydroxide > 0.1 normal calcium chloride-0.01 normal calcium chloride, 0.05 normal sodium hydroxide > 0.01 normal calcium chloride -sodium hydroxide > 0.01 calcium chloride, none, 0.01 normal sodium hydroxide > 1.0 normal calcium chloride-0.1 normal sodium hydroxide, 1.0 calcium chloride-0.05 sodium hydroxide, 1.0 normal calcium chloride.

The volume loss-time corrosion curves given in Figures 4, 5, and 6 show the rapid decrease in corrosion rates during first three days exposure. In the majority of the concrete mixes tested, the corrosion rates decreased throughout the exposure period. However, in mixtures using 0.05 and 0.1 normal sodium hydroxide, the corrosion curves appear linear with time after three to six days exposure. Table V shows the calculated corrosion rates for the mixes used, assuming linearity during the final twelve days exposure.

Galvanic Cells

The current-time relationships shown in Figures 7, 8, 9, and 10 were characterized by rather erratic behavior during the first twenty-four hours exposure. In this period the galvanic current fluctuated widely resulting in reversals of polarity of the strips, which were initially cathodic to the cup. Maximum current flow was reached after exposure of twelve to twenty-four hours. The strips were cathodic at maximum current. Current then tended to decrease with time toward zero. In some cases, the current reversed with the cup becoming cathodic.

TABLE V

STATIC CORROSION RATES OF 6061-T6 ALLOY IN CONCRETE

Admixture	Corrosion Rate (in^3/in^2-yr. 10^{-3})
0.10 N NaOH	13.4
0.05 N NaOH	10.1
0.10 N $CaCl_2$-0.1 N NaOH	9.7
0.01 N $CaCl_2$	8.8
0.10 N $CaCl_2$-0.01 N NaOH	8.6
0.01 N $CaCl_2$-0.01 N NaOH	8.1
0.01 N $CaCl_2$	8.1
None	7.7
0.01 N NaOH	5.9
1.0 N $CaCl_2$	0.4
1.0 N $CaCl_2$-0.05 N NaOH	1.1
1.0 N $CaCl_2$-0.10 N NaOH	1.2

*Calculated from mean of 12 day and 24 day results assuming linearity

The volume loss-time curves in Figures 11 and 12 were calculated from resistance data. The change in resistance indicates the true volume loss of aluminum only when attack was uniform. With pitting attack, the resistance increase is greater than would be estimated from weight loss data. Thus ratio of volume losses calculated from weight loss data to those calculated from resistance is an indication of the degree of pitting. Sharp

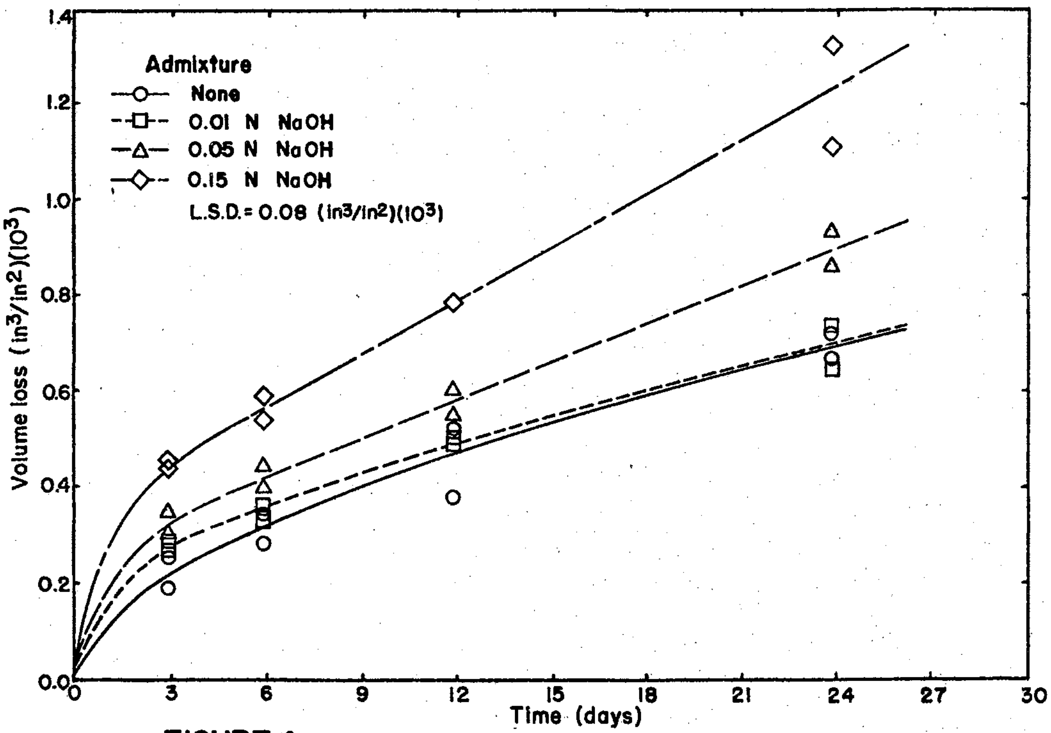

FIGURE 4 — Static corrosion tests of 6061-T6 alloy in concrete

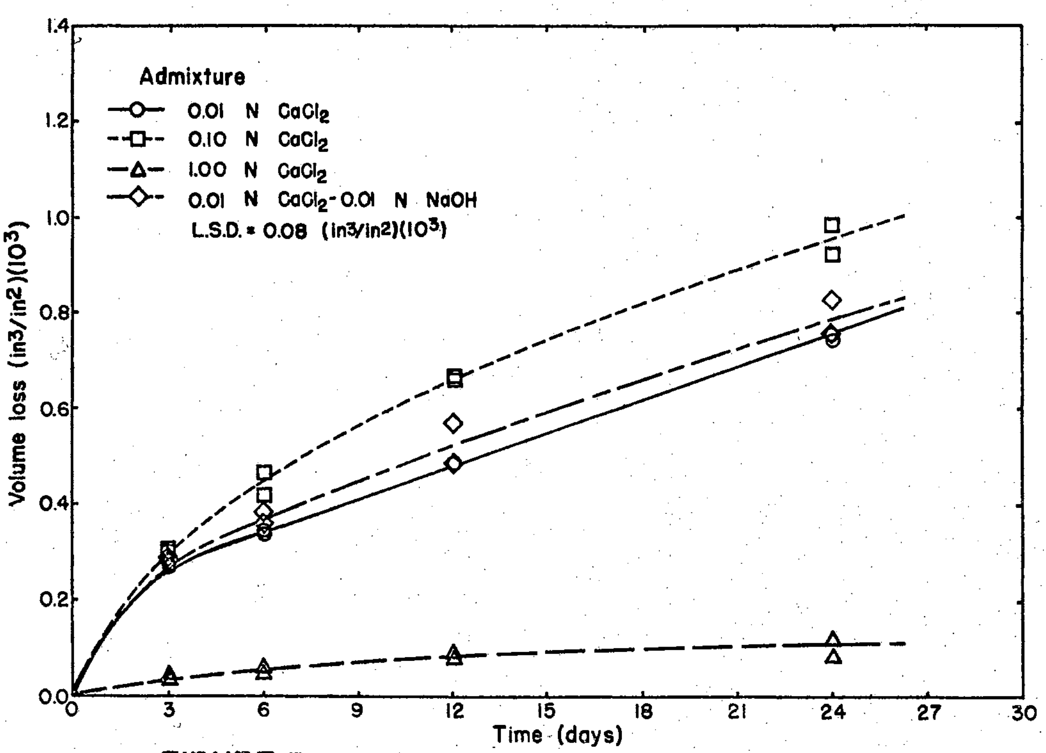

FIGURE 5 — Static corrosion tests of 6061-T6 alloy in concrete

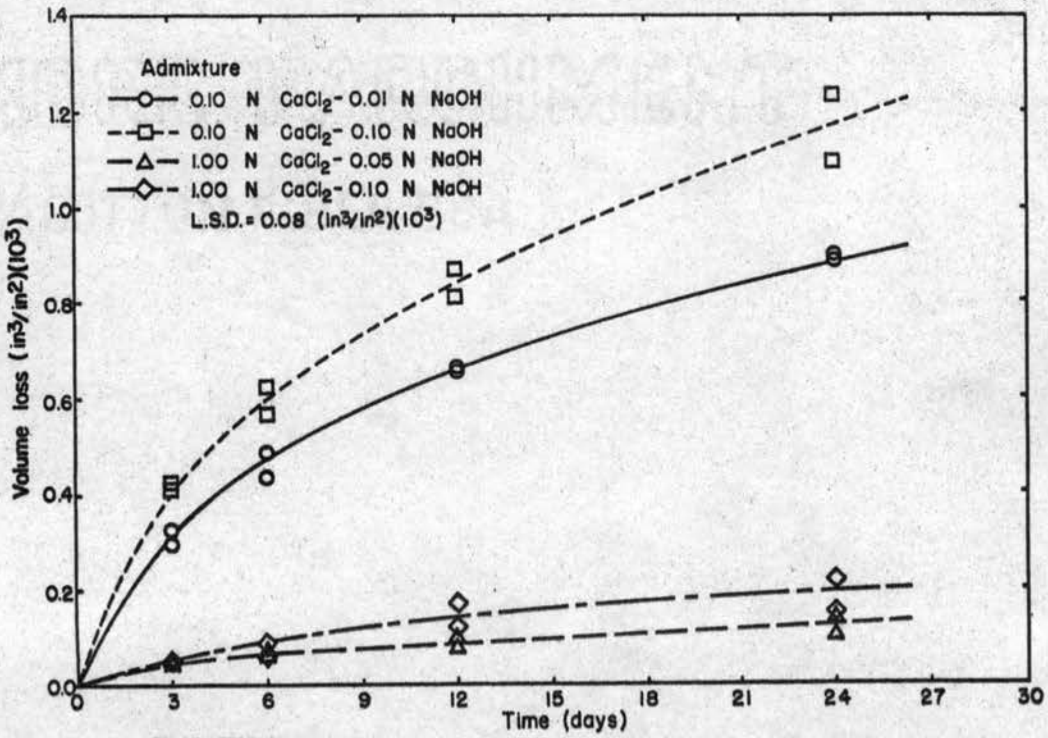

FIGURE 6 — Static corrosion tests of 6061-T6 alloy in concrete

breaks in these curves were attributed to initiation and cessation of pitting attack depending on the direction of the break.

Average volume losses of the cups and strips are given in Tables VI and VII. In the majority of the cells, the center strips were more severely corroded than were the cups. The rather marked difference in the corrosion resistance of 6061 and 5154 alloys noted in the aqueous corrosion tests was not evidenced in these tests. Statistical analysis indicated there was no effect of alloy. Visual examination of the strips revealed differences in attack of the alloys; the 6061 alloy was severely pitted with perforation of the strips in 0.1 and 0.05 normal hydroxide solutions; attack on 5154 alloy was a relatively uniform etch.

The coating used on the strips was satisfactory with no corrosion occurring on the protected areas. The Ucilon coating on the cups

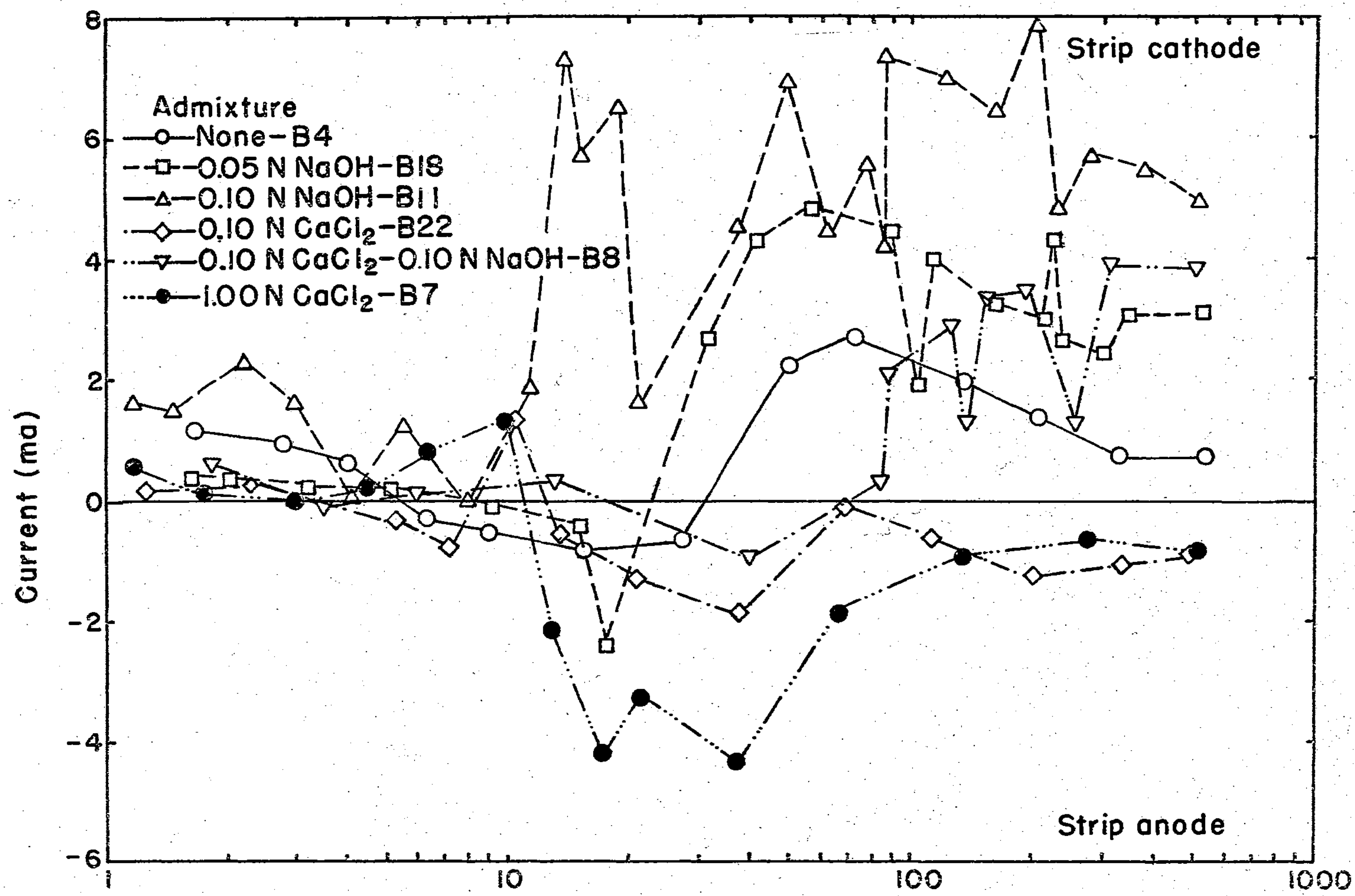

FIGURE 7— Current-time relationships for 6061–T6 Alloy

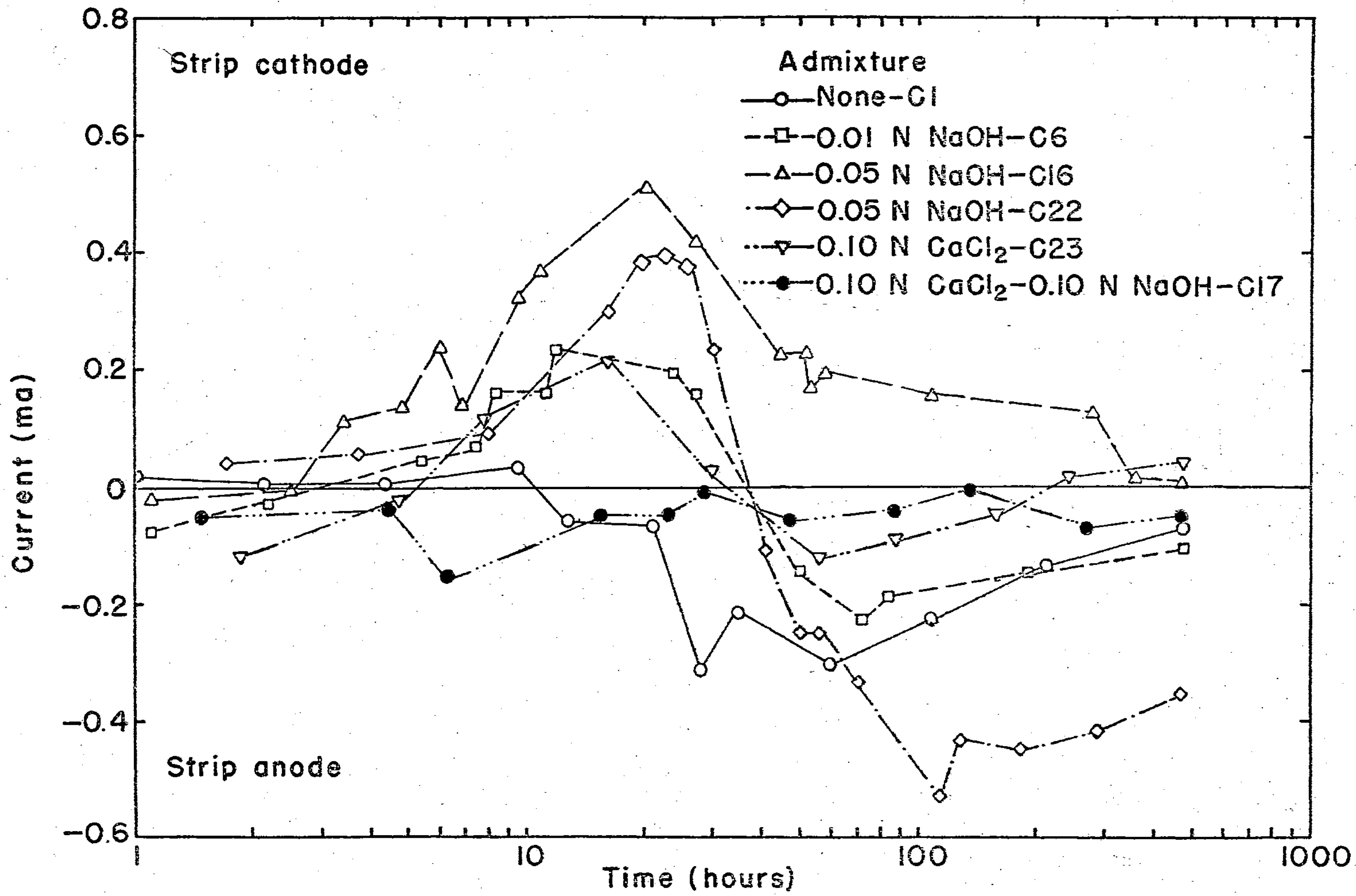

FIGURE 8— Current-time relationships for 6061-T6 alloy

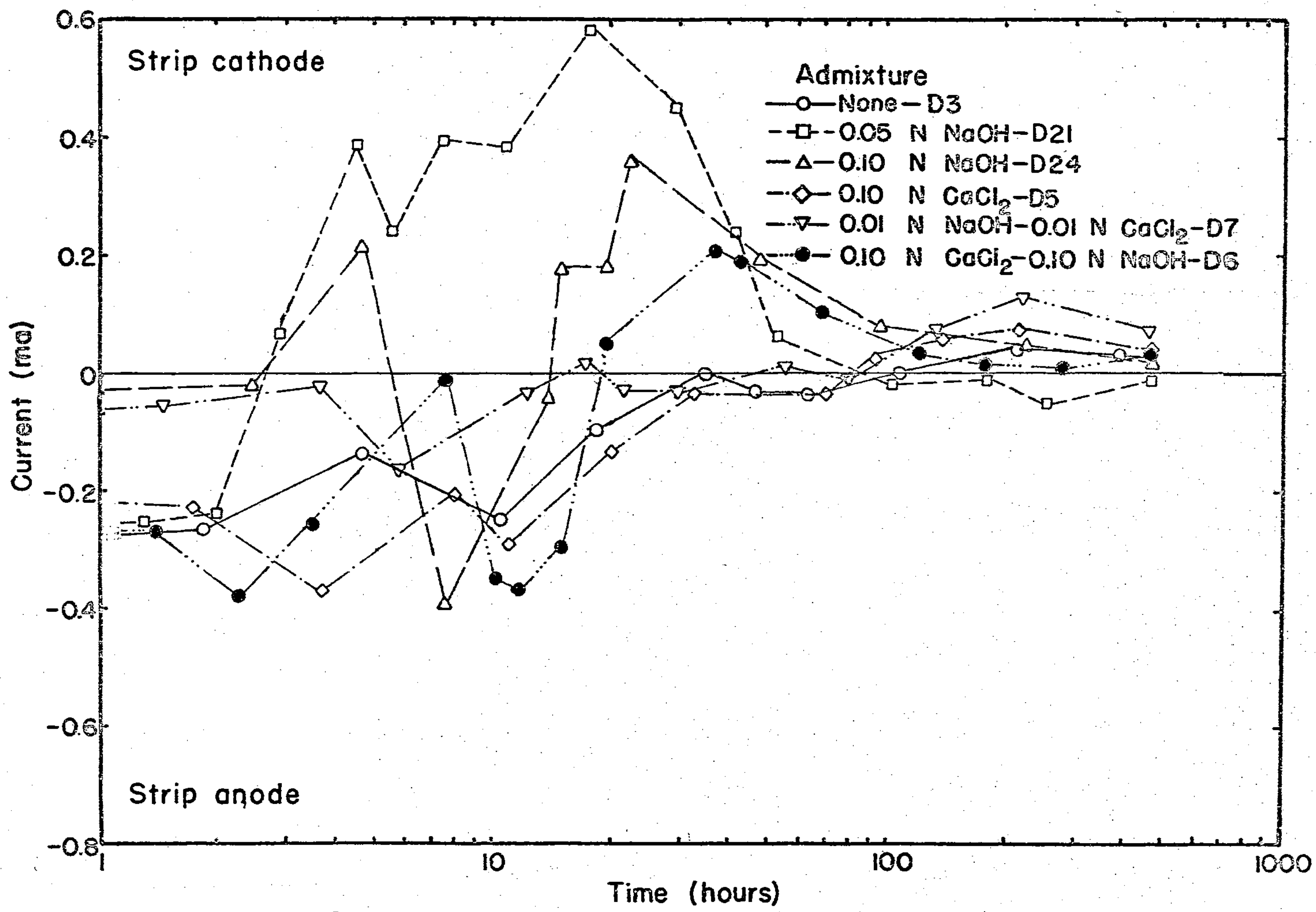

FIGURE 9 — Current–time relationships for 5154–H 34 alloy

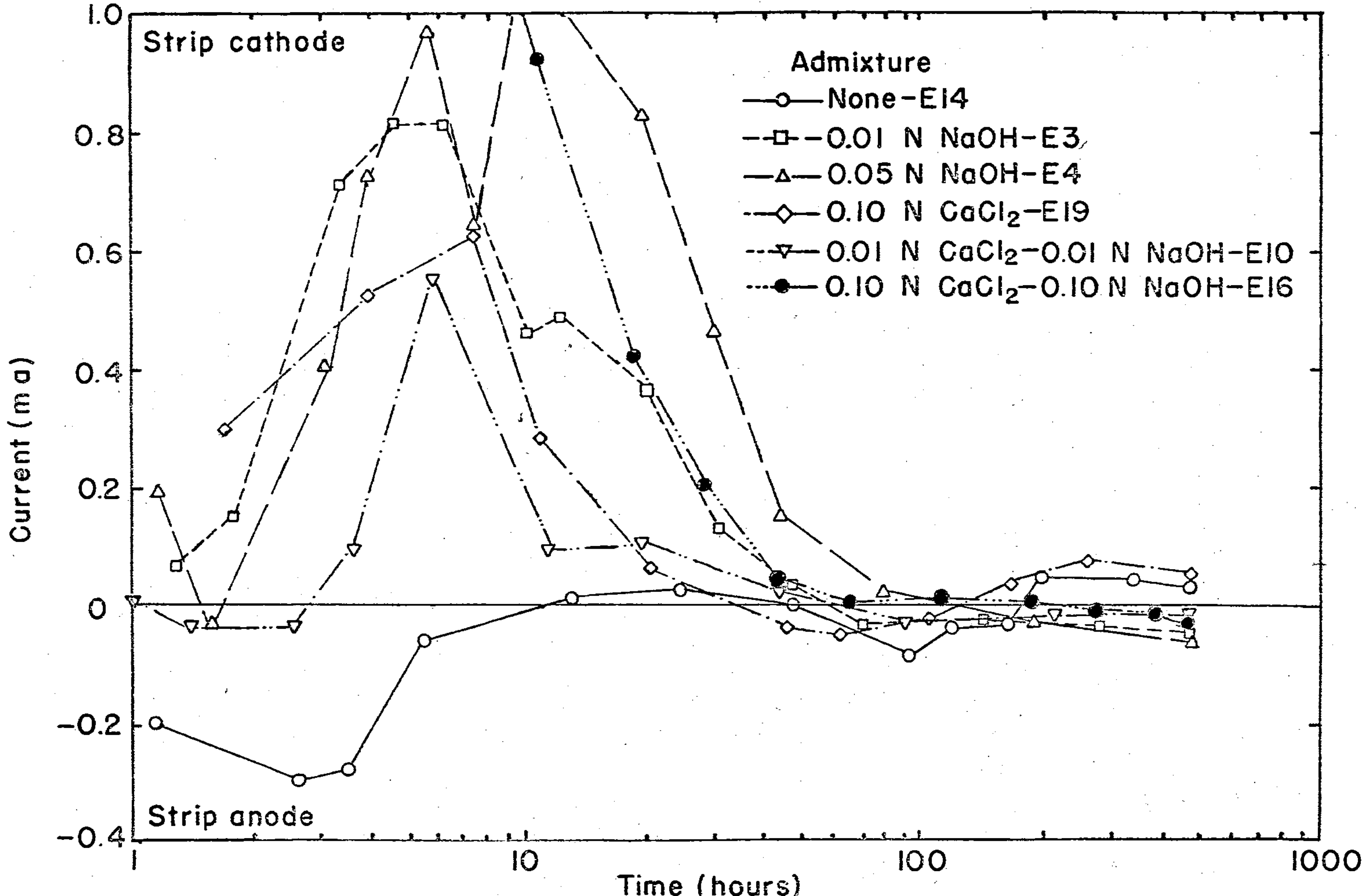

FIGURE 10— Current-time relationships for 5154-H34 Alloy

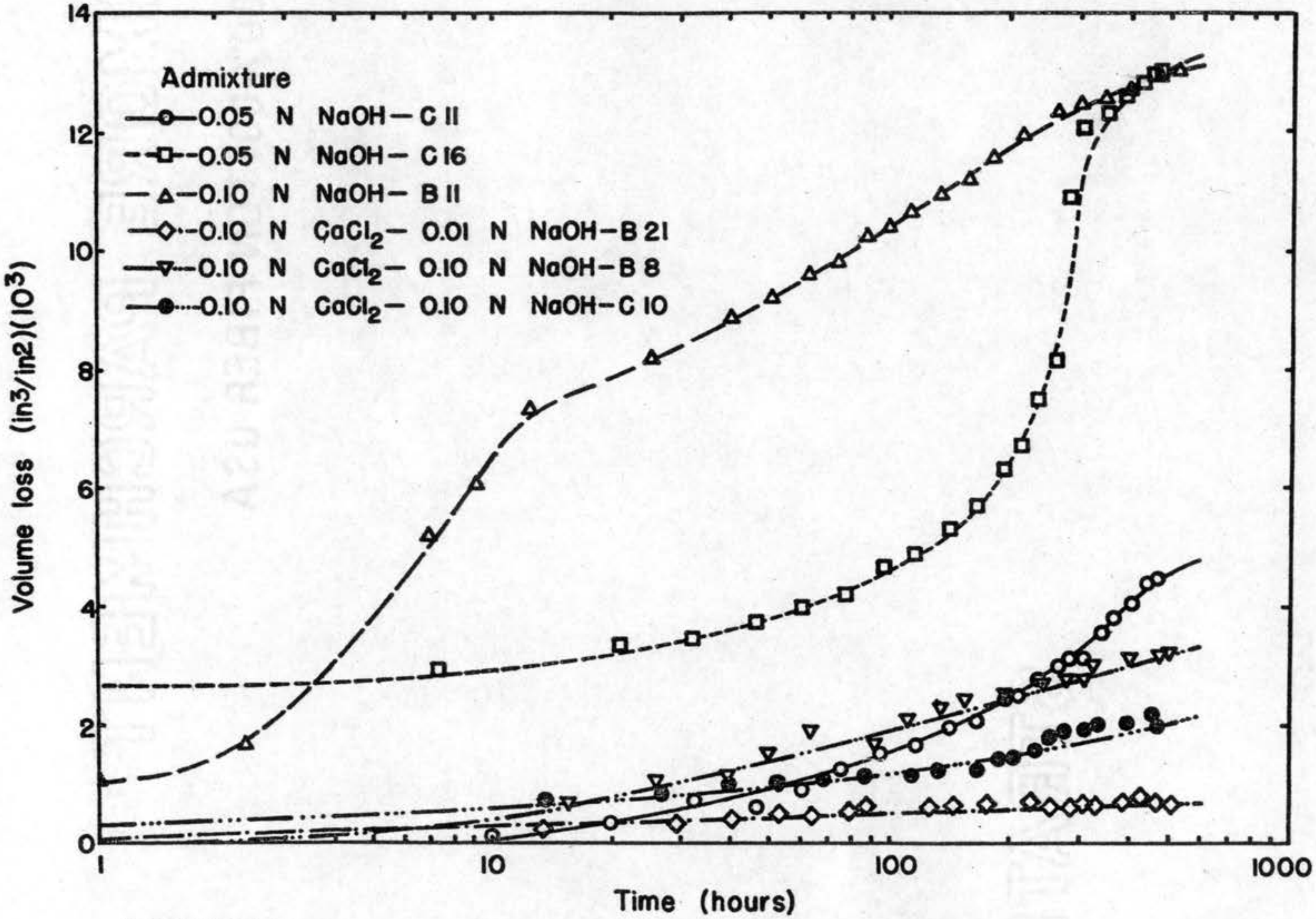

FIGURE 11— Calculated volume loss of 6061–T6 alloy by resistance change with time

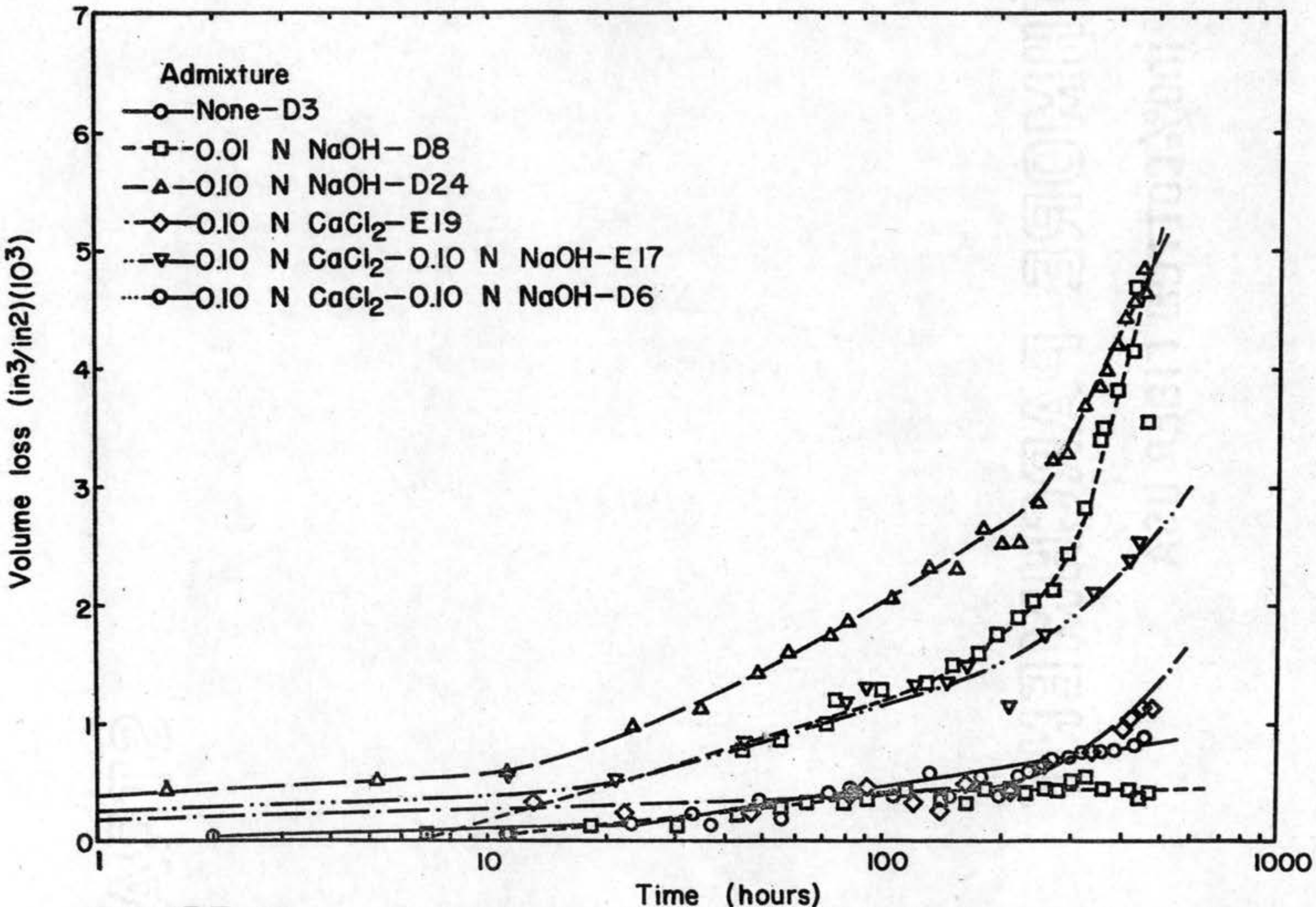

FIGURE 12 — Calculated volume loss of 5154-H34 alloy from resistance change with time

TABLE VI

AVERAGE VOLUME LOSSES FOR GALVANIC CELLS

TESTING EFFECT OF MIX AND ALLOY

Mix No.*	pH	Volume Loss of Strips ($in^3/in^2 \times 10^3$)	
		6061-T6	5154-H34
4	12.6	9.041	4.987
3	12.5	2.208	3.552
2	12.5	1.930	0.863
10	12.4	1.200	1.742
1	13.5	1.099	1.087
8	12.5	0.701	1.077
5	12.5	0.649	0.887
9	12.4	0.579	0.770
6	12.3	0.556	0.582
12	12.1	0.225	0.256
7	12.0	0.157	0.247
11	11.9	0.133	0.210

$S_{\bar{x}} = 0.336\ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.98\ in^3/in^2 \times 10^3$

Mix No.	pH	Volume Loss of Cups ($in^3/in^2 \times 10^3$)	
		6061-T6	5154-H34
6	12.3	1.322	0.492
10	12.4	1.216	0.694
1	12.5	0.925	0.445
9	12.4	0.786	0.499
3	12.5	0.738	0.753
4	12.6	0.635	1.631
5	12.5	0.548	0.798
8	12.5	0.537	0.556
2	12.5	0.426	0.640
7	12.0	0.094	0.072
12	12.1	0.067	0.094
11	11.9	0.057	0.070

$S_{\bar{x}} = 0.155\ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.452\ in^3/in^2 \times 10^3$

*Mixes are defined in Table II

TABLE VII

AVERAGE VOLUME LOSSES FOR GALVANIC CELLS

TESTING EFFECT OF ALLOY, AREA, AND MIX

		Volume Loss of Strips ($in^3/in^2 \times 10^3$)					
		6061-T6			5154-H34		
Strip Area in^2		2.0	1.5	0.75	2.0	1.5	0.75
Mix No.	pH						
3	12.5	2.208	4.691	2.849	3.552	2.663	3.017
2	12.5	1.930	1.404	1.184	0.863	1.991	1.667
10	12.4	1.200	1.119	1.130	1.742	1.508	0.993
1	12.5	1.099	1.029	0.807	1.087	0.836	1.091
8	12.5	0.701	1.314	1.037	1.077	1.447	1.294
6	12.3	0.556	0.663	0.531	0.582	0.638	0.602

$S_{\bar{x}} = 0.305 \ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.875 \ in^3/in^2 \times 10^3$

		Volume Loss of Cups ($in^3/in^2 \times 10^3$)					
		6061-T6			5154-H34		
Strip Area in^2		2.0	1.5	0.75	2.0	1.5	0.75
Mix No.	pH						
6	12.3	1.322	0.338	0.318	0.492	0.535	0.455
10	12.4	1.216	0.715	0.613	0.694	0.970	0.627
1	12.5	0.925	0.341	0.451	0.445	0.587	0.747
3	12.5	0.738	1.112	0.639	0.753	0.981	0.871
8	12.5	0.537	0.356	0.491	0.556	0.670	0.626
2	12.5	0.426	0.634	0.567	0.640	0.566	0.665

$S_{\bar{x}} = 0.227 \ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.648 \ in^3/in^2 \times 10^3$

blistered in some cases resulting in some attack of the cup under the supposedly protective coating.

Electrolytic Tests

An unexpected consequence of impressing electric current on aluminum test coupons was the rapid dissolution of aluminum at the cathode. Figures 13, 14, 15, 16, 17, and 18 show the relationship of current density with the corrosion of aluminum cathodes in three different concrete mixes. In contrast to the rapid stifling of attack in the absence of impressed current, corrosion rates increased both with time and current density.

Appearances of the corroded coupons were very similar. Severe thinning of the coupons as well as pitting attack with perforation resulted after six days exposure in a 0.1 normal calcium chloride mix at a current density of one milliampere per square inch. At this current density, the same attack was seen after 12 days in distilled water and in 0.1 normal calcium chloride-sodium hydroxide mixes.

The plastic coating used was satisfactory when coupons were anodic, but when the coupons were made the cathode the film was lifted by gas evolution from the front surface of the sample at 1.0 and 0.5 milliamperes per square inch, allowing corrosion to proceed over part of the supposedly protected area. With a current density of 0.2 milliamperes per square inch or less the coating was satisfactory.

Attack on the aluminum anodes was highly localized with severe pitting. The total weight losses and maximum pit depths were less than on the corresponding cathode. Large areas of the aluminum anodes were passivated. In chloride-free concrete the passivation was shown by the large potential drop across the concrete-aluminum interface. This

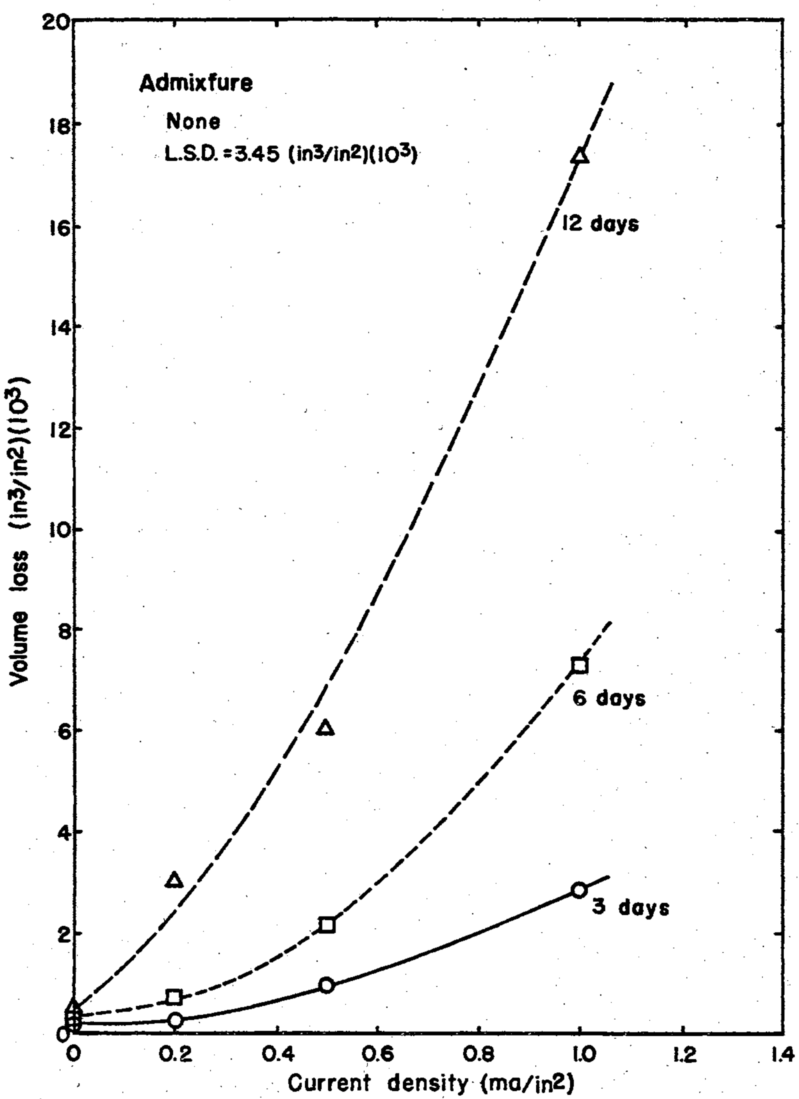

FIGURE 13— Effect of impressed cathodic current on volume loss

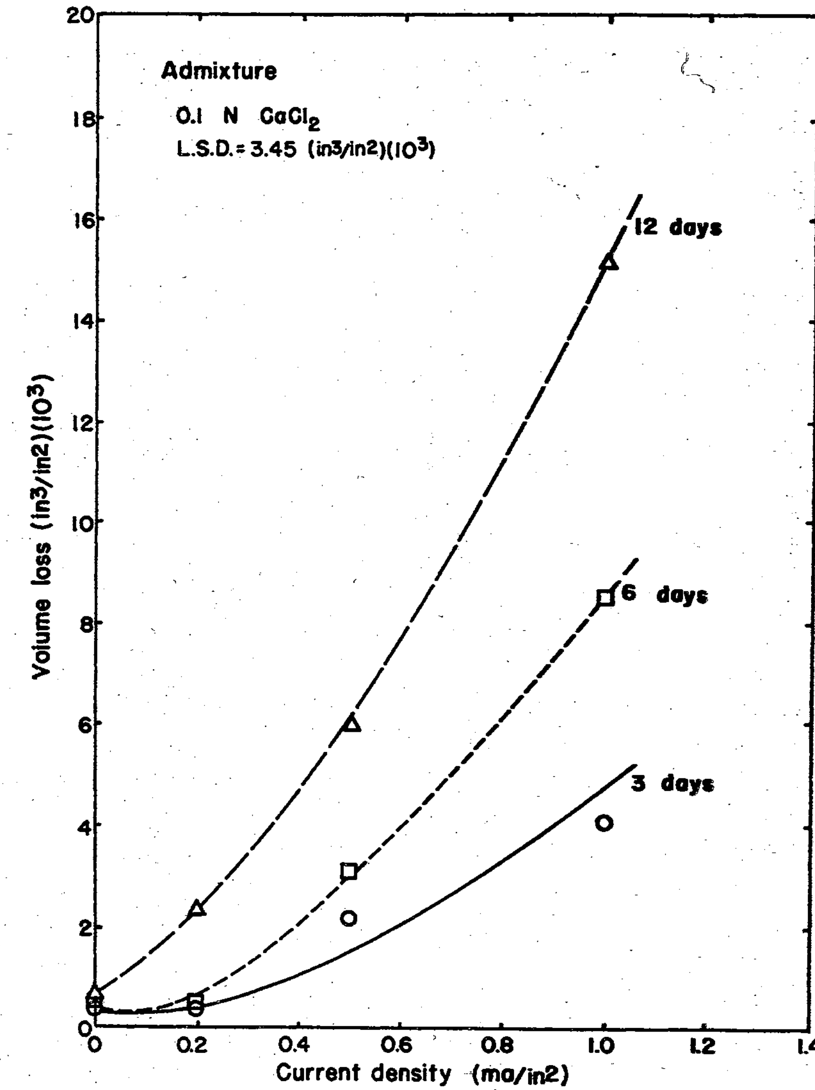

FIGURE 14— Effect of impressed cathodic current on volume loss

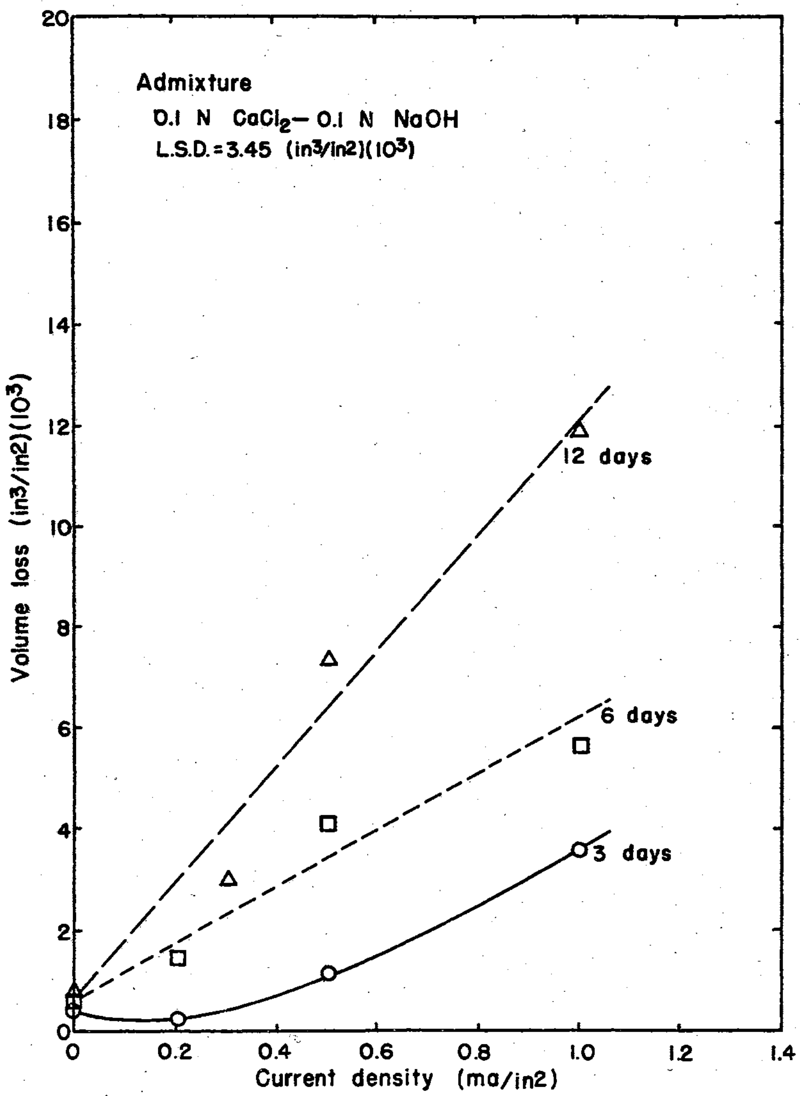

FIGURE 15 — Effect of impressed cathodic current on volume loss

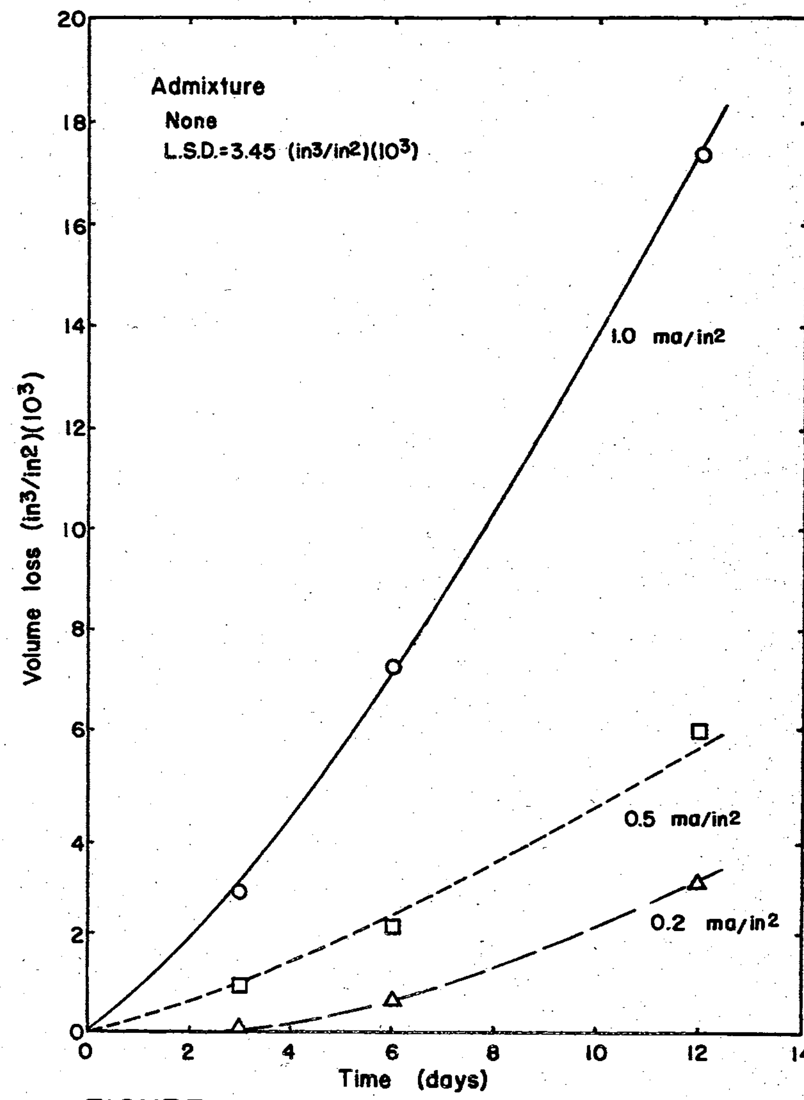

FIGURE 16 — Volume loss — time curves at constant cathodic current density

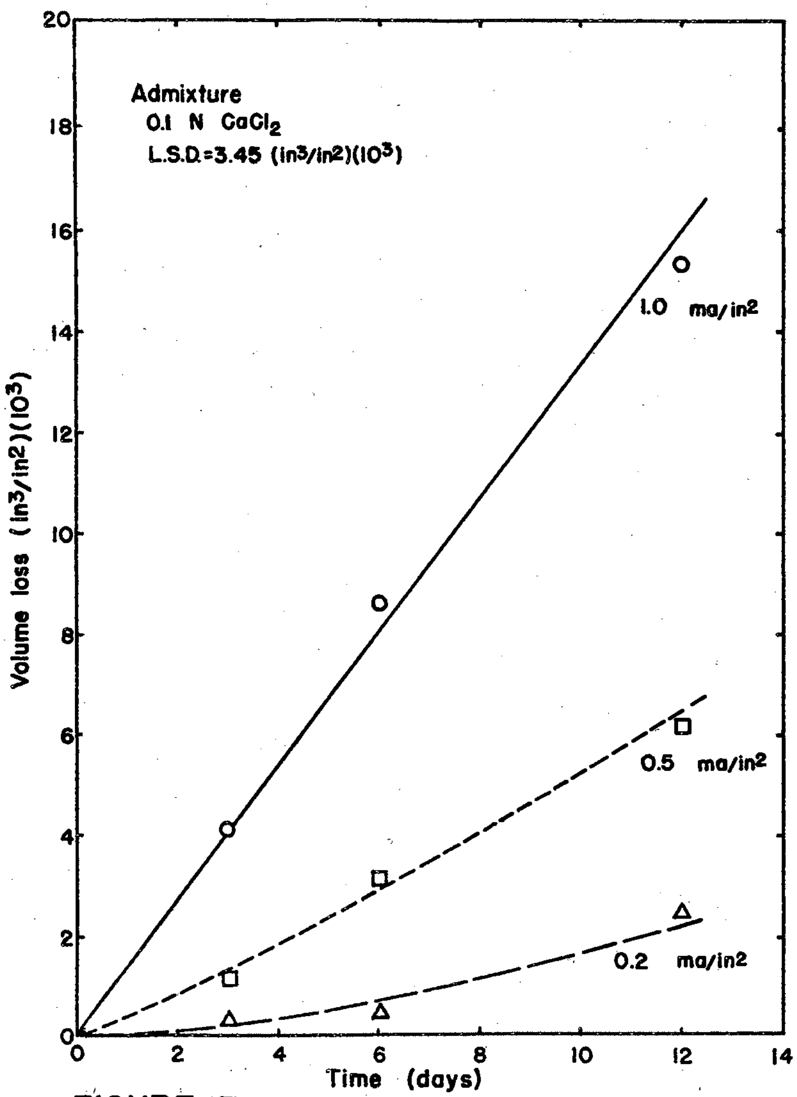

FIGURE 17— Volume loss—time curves at constant cathodic current density

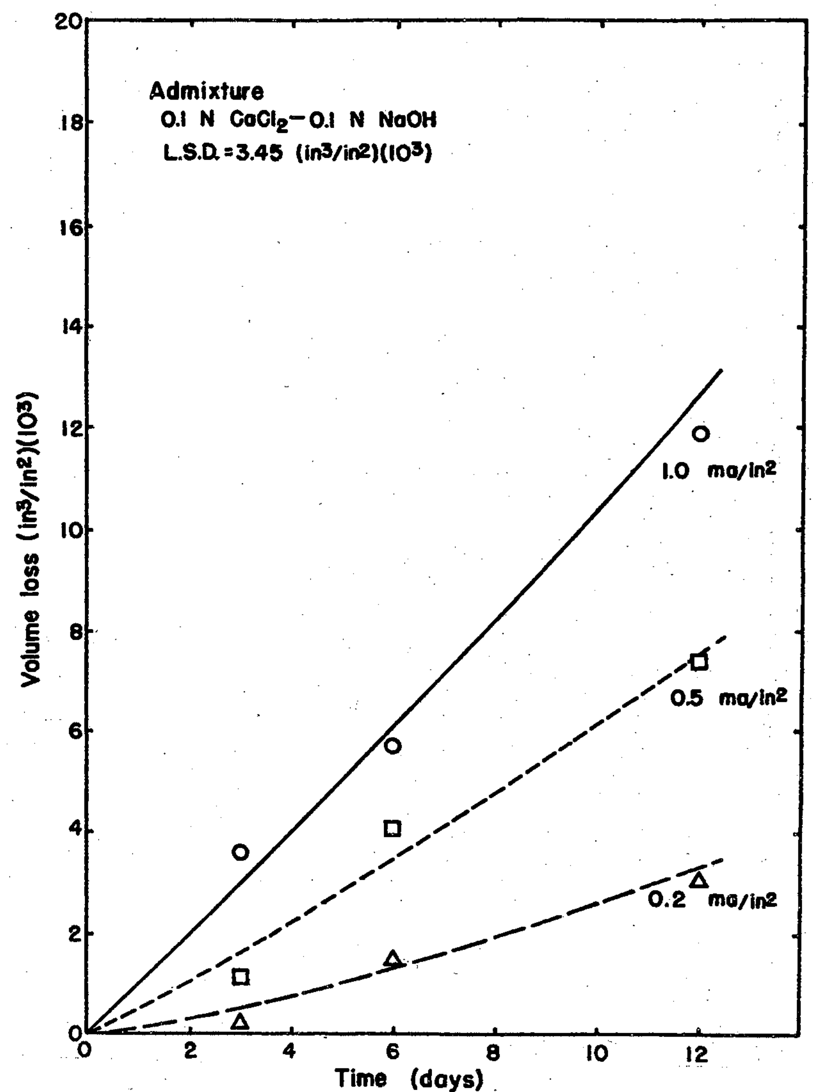

FIGURE 18— Volume loss—time curves at constant cathodic current density

anodizing effect resulted in corrosion rates less than theoretically would occur at 100 percent current efficiency. In chloride admixtures, there was still passivation of certain areas on the anode. However, the chloride served to break down the film at discrete points. Thus there was little increase in potential difference across the cell with time. The current efficiency was also slightly over 100 percent. These results are shown in Figures 19, 20, and 21.

Potential measurements of the iron anodes indicate the potential increase noted in chloride free concrete were a result of polarization of the aluminum and not a result of electrolytic effects in the concrete. The potential-time relationships are shown in Figures 22, 23, 24, and 25.

The above observations are illustrated in Plates IV and V.

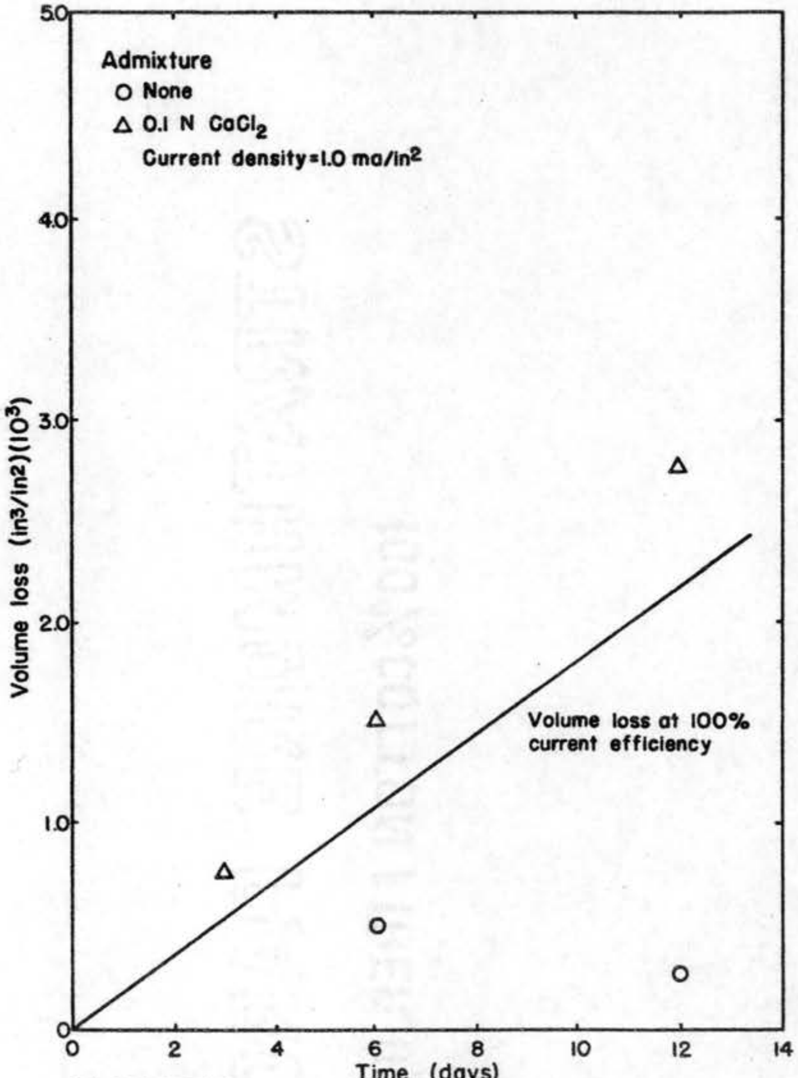

FIGURE 19 — Volume loss–time curves at constant anodic current density

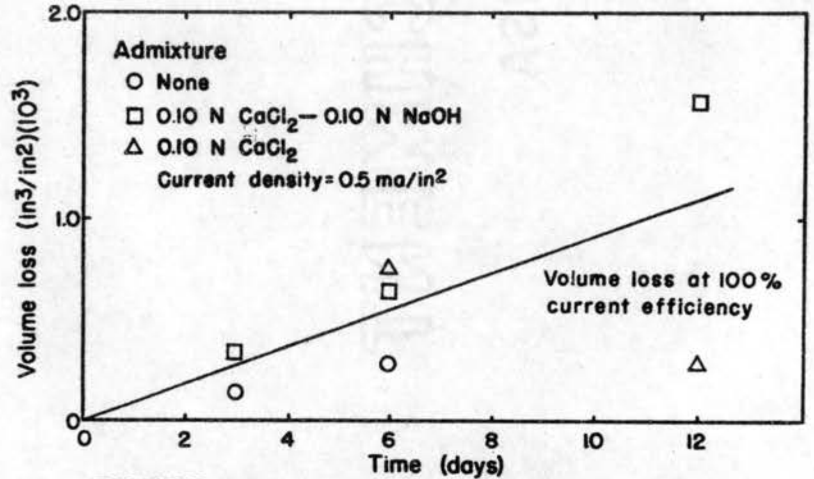

FIGURE 20 — Volume loss–time curves at constant anodic current density

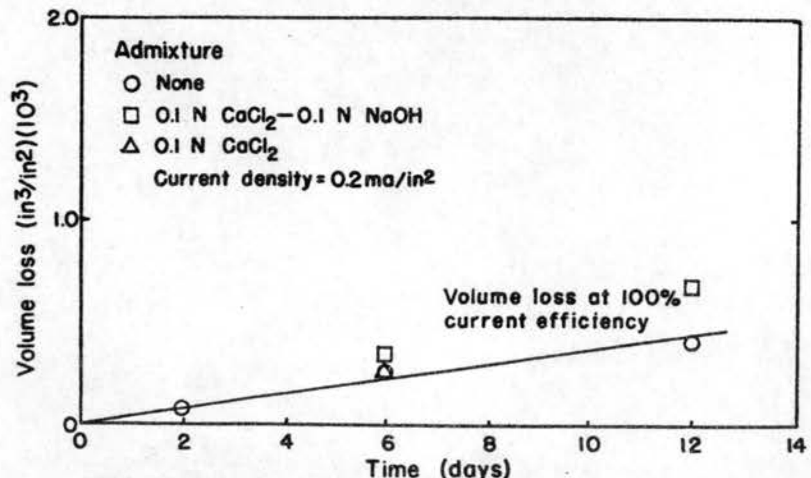

FIGURE 21 — Volume loss–time curves at constant anodic current density

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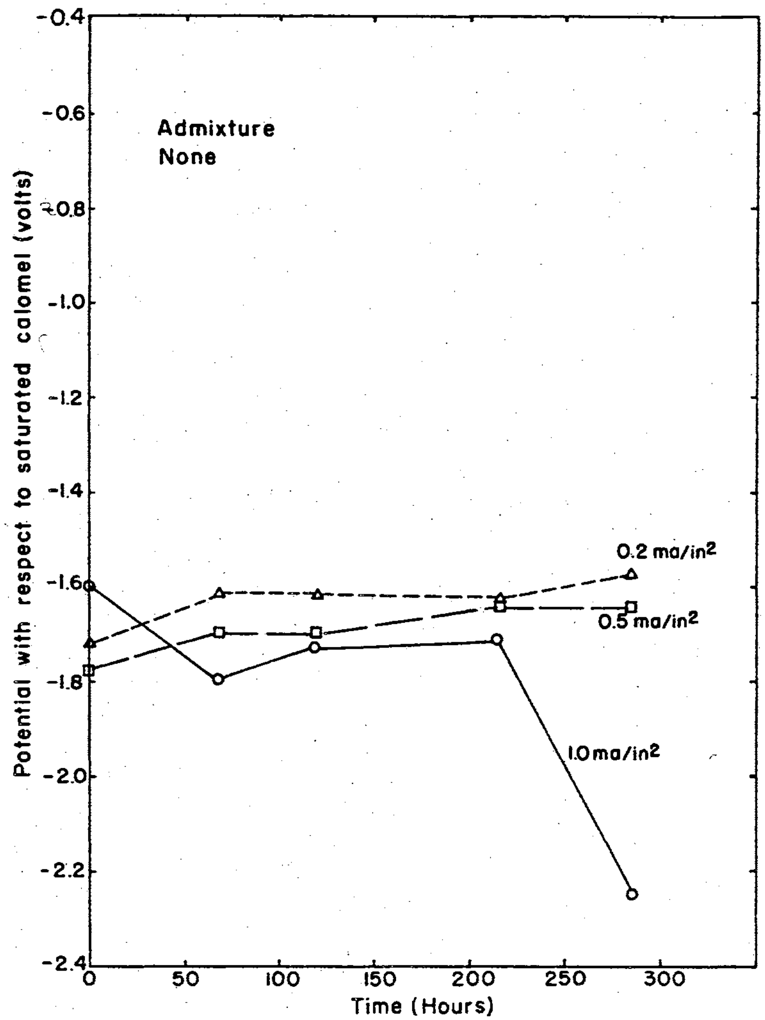


FIGURE 22–Potential-time relationship of cathodes

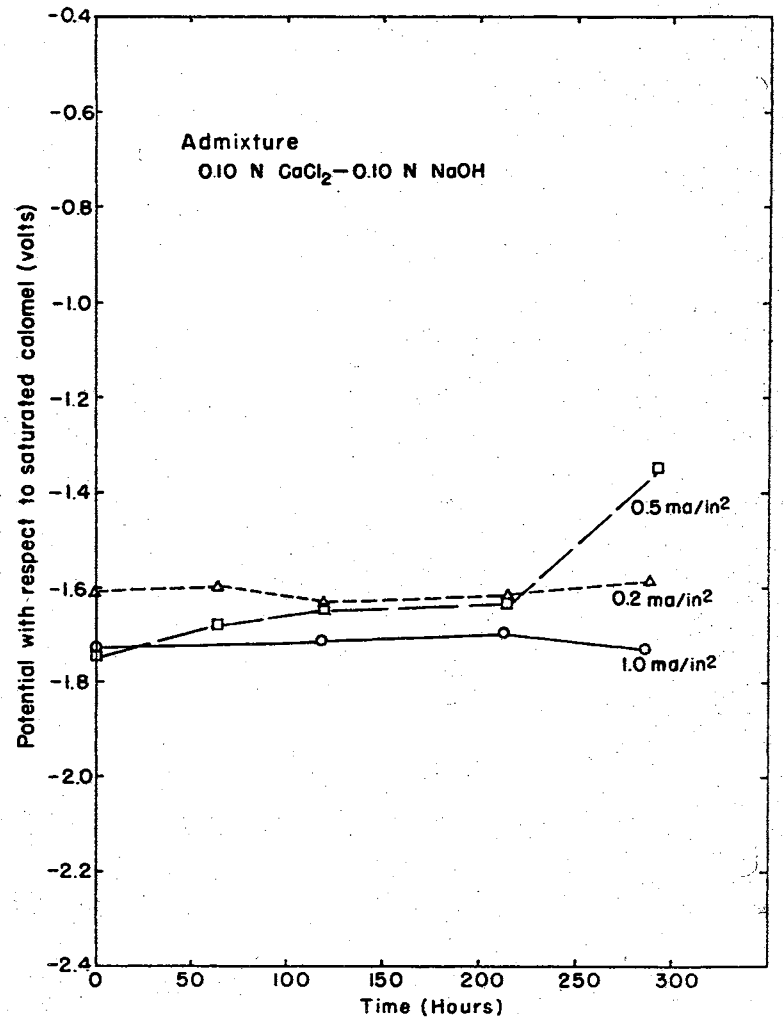


FIGURE 23–Potential-time relationship of cathodes

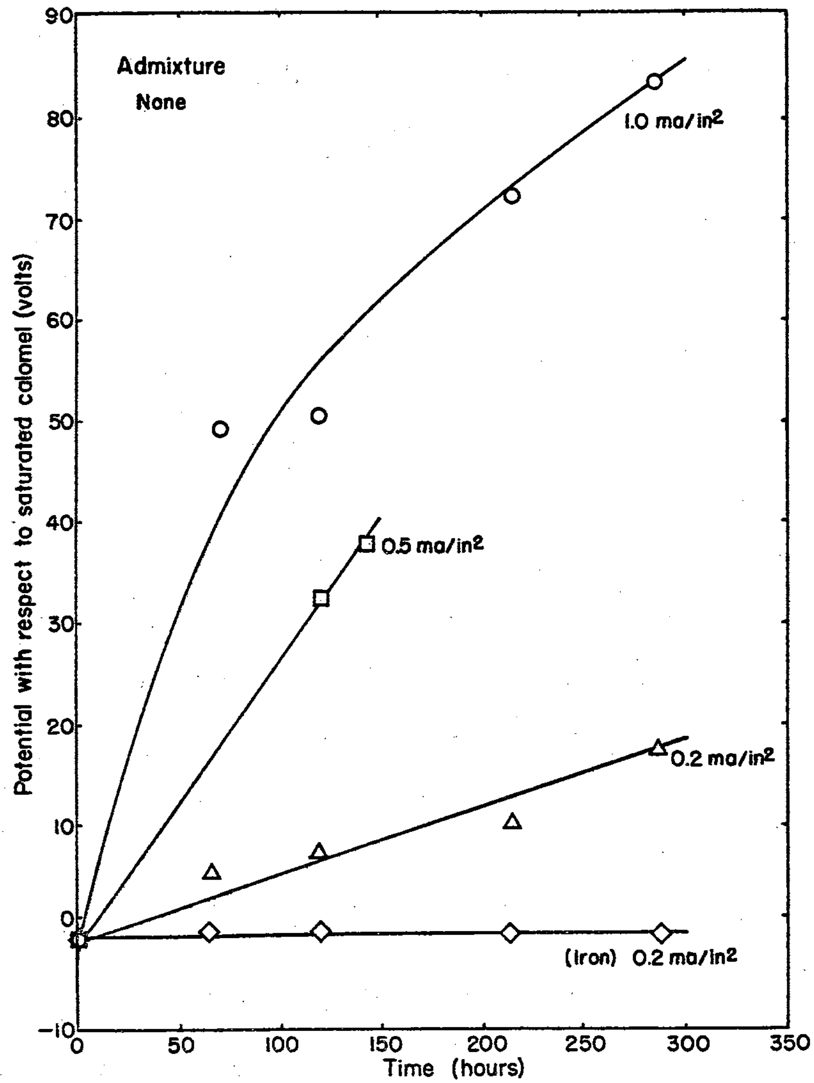


FIGURE 24—Potential-time relationship of anodes

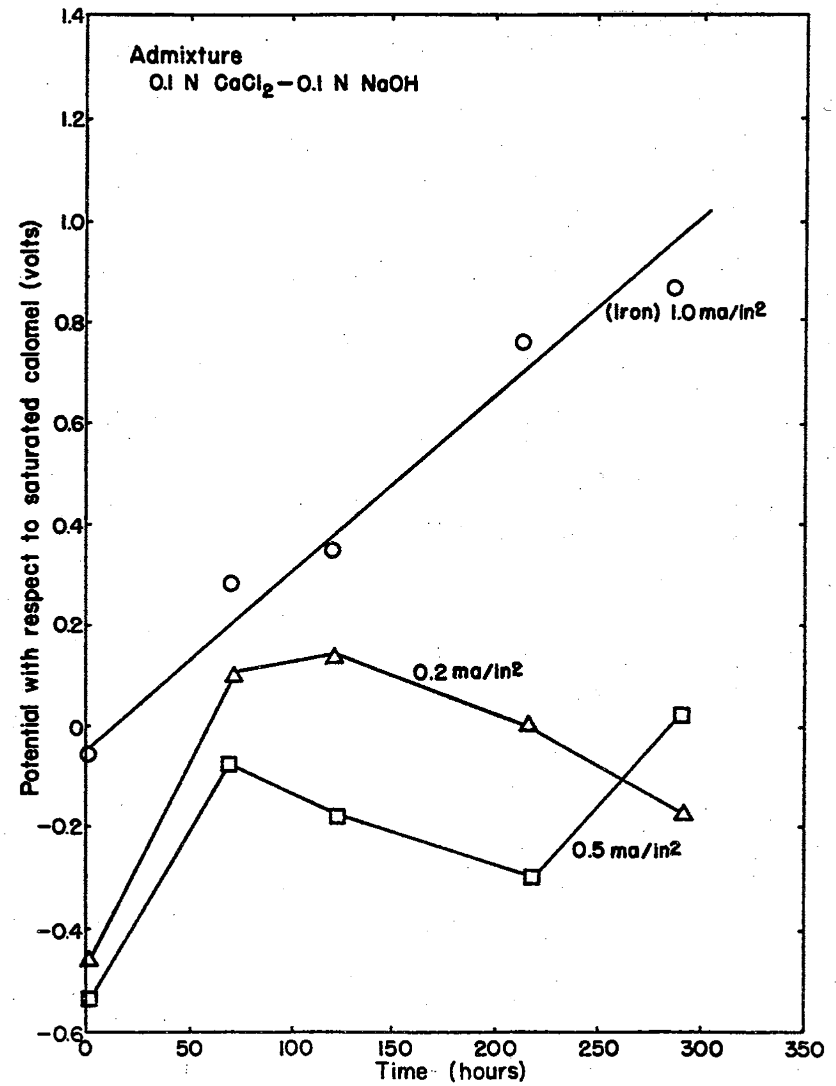


FIGURE 25—Potential-time relationship of anodes

PLATE IV

EFFECT OF IMPRESSED CURRENT ON THE CORROSION OF ALUMINUM

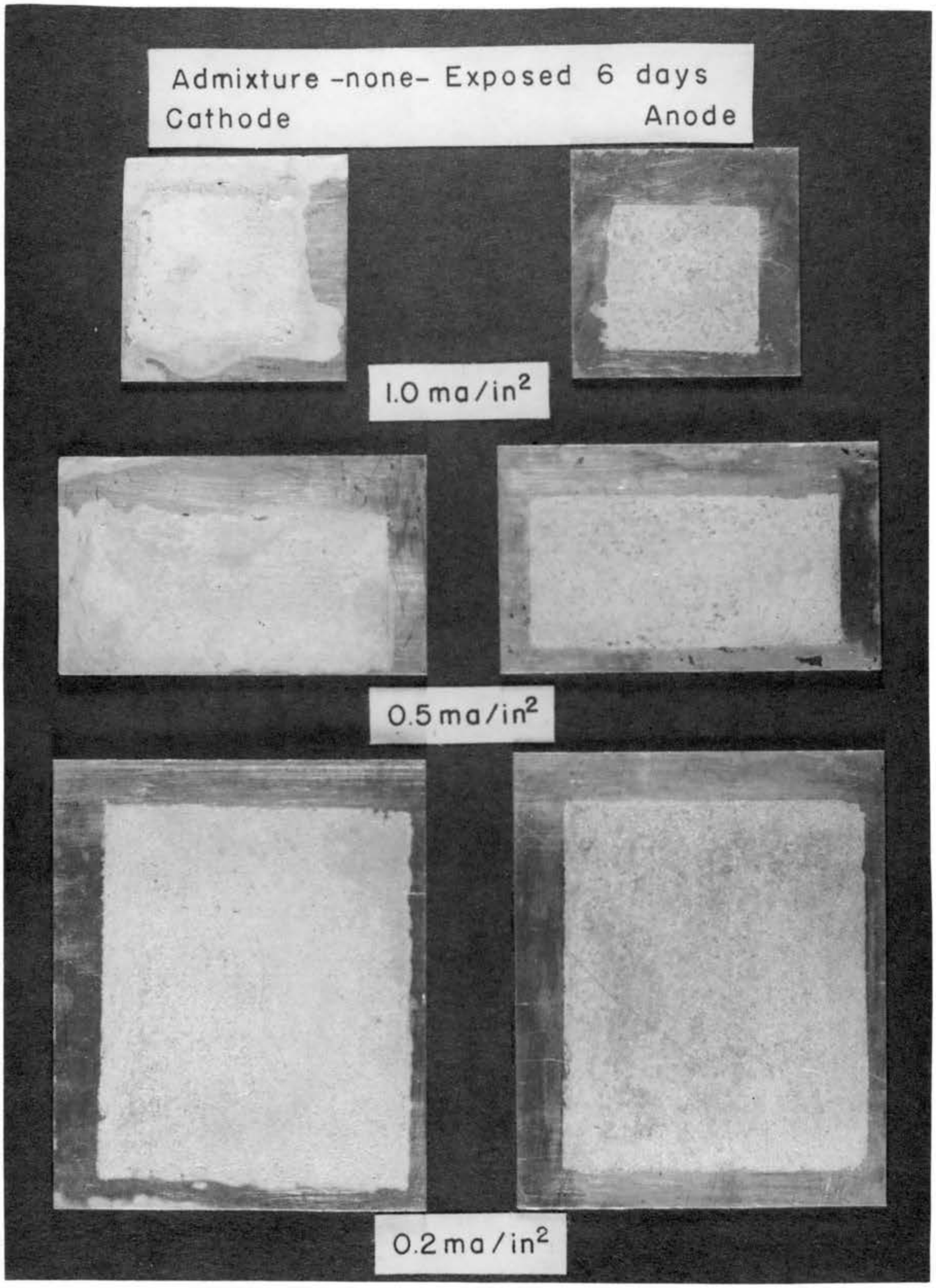
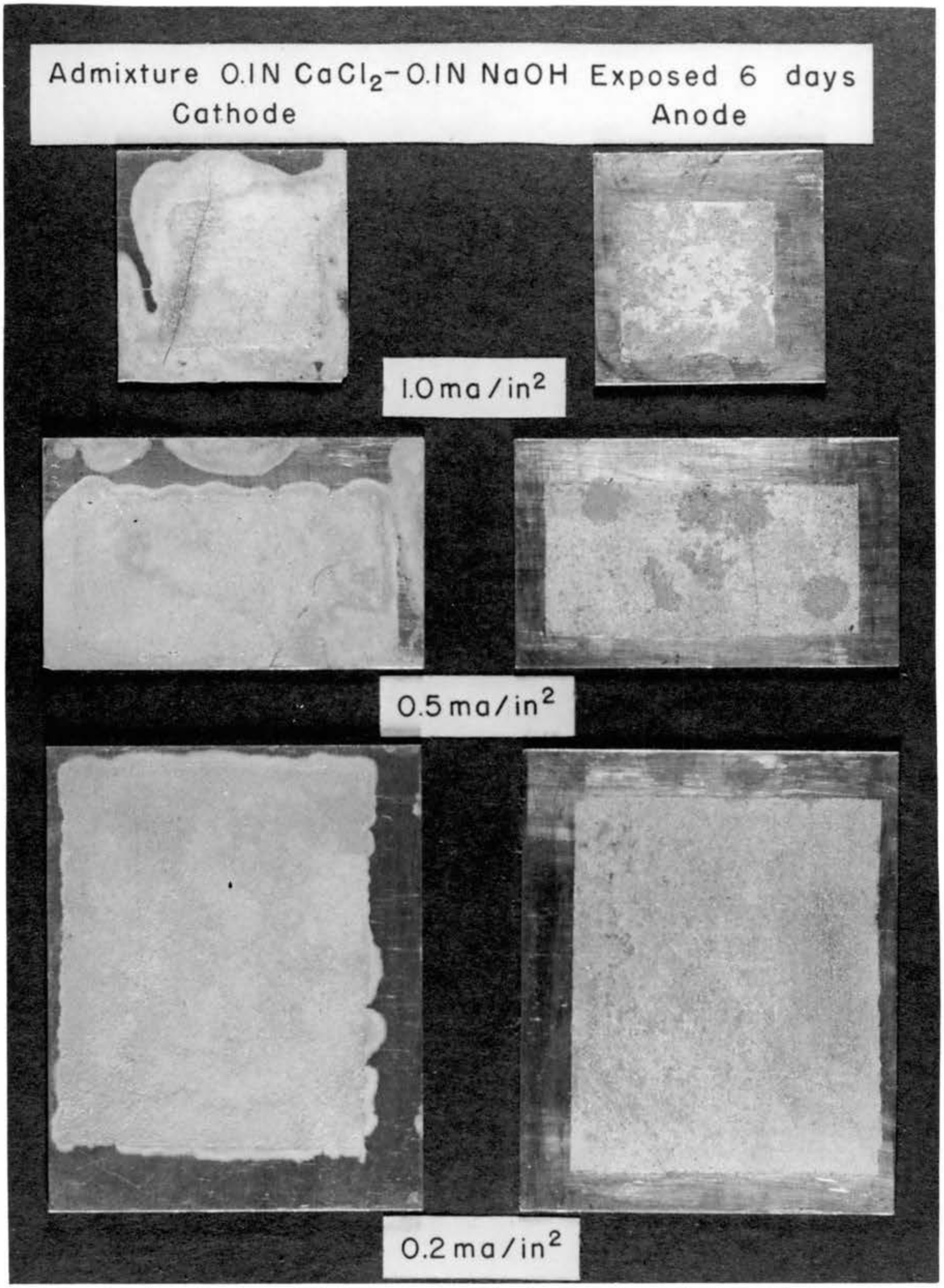


PLATE V

EFFECT OF IMPRESSED CURRENT ON THE CORROSION OF ALUMINUM



CHAPTER V

DISCUSSION OF RESULTS

The results of the static corrosion tests reveal that corrosion of aluminum in alkaline solutions is dependent on the cations present as well as on the pH. Ammonium and calcium hydroxides were significantly less corrosive to aluminum than was sodium hydroxide when all solutions were adjusted to the same pH. In a solution of saturated calcium hydroxide - 0.1 normal sodium carbonate the precipitation of calcium ion as the carbonate leaves very little calcium in solution. This low concentration of calcium did limit the attack somewhat and some parts of the strips were protected. In sodium hydroxide-0.1 normal ammonium chloride the 6061 alloy was very severely pitted. These results indicate that calcium and ammonium ions effect formation of protective films.

The situation in concrete is different. Since concrete contains calcium aluminate salts as well as calcium hydroxide, the water phase will be saturated with calcium ion. Addition of calcium chloride to the concrete decreases the pH of the mixture slightly, resulting in an increase in calcium ion concentration. Thus, if the rate of formation and protectiveness of the film formed on the aluminum surface is dependent on the concentration of the calcium ion present, additions of calcium chloride should decrease corrosion rates. However, the film penetrating ability of the chloride ion offsets this somewhat. Additions of sodium hydroxide, on the other hand, would increase the pH slightly and suppress the concentration of calcium, increasing corrosion rates. These effects are moderated considerably by the availability of calcium from the solid cement phase and the buffering effect of the concrete. As a result, addition of sodium and calcium ions to concretes has much less effect on corrosion than would the same additions to aqueous solutions. This was borne out by the results of the corrosion tests in concrete.

When the concrete was not in contact with the aluminum as in the water phase of the galvanic cells, the effect of the added ions on film formation was much more pronounced. Addition of sodium hydroxide solutions increased corrosion somewhat with or without equivalent additions of calcium chloride. Addition of calcium chloride alone reduced corrosion rates, with little corrosion in 1.0 normal calcium chloride admixtures.

The galvanic cells were not very reproducible and there was no definite correlation of concrete admixture with the polarity of the center strip. Current flow tended toward higher average values in sodium hydroxide admixtures than in plain concrete or high calcium chloride mixes. Current flow approached zero sooner when using 5154-H34 alloy indicating a more protective film. There was no indication of protection of the center strips when they were cathodic. In fact, the most severe corrosion and the only perforations noted were when the strips were strongly cathodic.

The current flow arising from the galvanic cells was not a factor in the corrosion of the anodic part of the cells. The severe corrosion of the cathodes in the electrolytic cells as well as the severity of corrosion of the cathodic strips indicate that even very low current densities at the cathode result in severe corrosion.

The effect of hydroxyl ion was shown by the severe corrosion of aluminum cathodes. The cathodic reaction in these tests was hydrogen evolution, which resulted in a build up of hydroxyl ions at the aluminum-concrete interface. Diffusion of the hydroxyl ions away from the surface is dependent on concentration gradient and ion mobilities. These processes are slow enough at a solid-solid interface to permit formation of a hydroxyl concentration high enough to break down any protective film on the metal. At the anode, on the other hand, the anodic reaction was oxidation of aluminum. Aluminum ion reacted with hydroxyl ion to reduce the pH and precipitated as a protective film in the absence of chloride. These effects are shown by the potential-time curves in Figures 22, 23, 24, and 25.

The rapid increase in potential of aluminum anodes in chloride free concrete is indicative of film formation. The aluminum surface was passivated at high current densities (1.0 and 0.5 milliamperes per square inch) and processes other than oxidation of the aluminum occurred. Chlorides, however, broke down this film at discrete areas. As a consequence the anode was severely pitted and total volume losses were slightly higher than theoretically would occur at 100 percent current efficiency. At the cathode, the relatively constant potential difference indicated that any film formed was immediately broken down with little reduction of local action current.

CHAPTER VI

SUMMARY AND CONCLUSIONS

To define conditions under which aluminum will be severely corroded by concrete, a series of corrosion tests were made in which aluminum alloys 6061-T6 and 5154-H34 were exposed to alkaline solutions and various concrete mixes. The solutions tested the effect of sodium, ammonium and calcium ions with chloride, carbonate, and hydroxyl ions at the concentrations and pH's which could occur in concrete. The concrete contained admixtures of calcium chloride and sodium hydroxide in various proportions. Static, galvanic, and electrolytic tests were made. A total of 534 cleaned and weighed samples were exposed, in addition to some preliminary tests. This number was necessary because of the numerous factors involved and to provide some measure of reproducibility.

Static corrosion tests in alkaline solutions showed that the kind and concentrations of cations present were as important as the pH in determining corrosion rates. Calcium and ammonium ions aid in formation of insoluble aluminate films, sodium ions do not. The effect of anions was much less pronounced. Chloride ion caused severe pitting in a mixture of sodium and ammonium ions.

Static corrosion tests in concrete showed that additions of sodium hydroxide increased corrosion rate with or without equivalent additions of calcium chloride; calcium chloride alone had little effect except in 1.0 normal calcium chloride admixtures, which reduced corrosion to insignificant values.

The galvanic tests were designed to estimate the effect of voids in concrete. In general, there was more corrosion in the void than in the concrete but this was not closely related to galvanic current flow, which was rather erratic and unpredictable. Here again sodium ion increased corrosion rate while calcium chloride in sufficient quantity stifled attack.

The most surprising and unexpected result of the electrolytic tests was the very destructive effect of cathodic current on aluminum. The anodes were less severely corroded than would be expected from the ampere hours passed except in chloride admixtures when corrosion exceeded that calculated from Faraday equivalents.

From these results the following conclusions are believed to be justifiable:

1. Excessive corrosion of aluminum in moist concrete is not an inherent characteristic of ordinary concrete. The rate of attack will be influenced by certain admixtures to concrete—notably, addition of sodium ion, which increases corrosion rates, while calcium chloride in sufficient quantities stifles attack.

2. Aluminum may suffer severe attack as a consequence of voids at the concrete-aluminum interface. This is a result of the greater corrosivity of the water phase and the galvanic effect between the aluminum contacting the concrete and that at the void. The severity is increased when the aluminum at the void is the cathode. Use of Alclad alloys may also be dangerous in that once the clad is penetrated, aggravation rather than stifling of attack of the base metal may well result from the galvanic action.

3. While stray currents do not always cause excessive attack of both anodic and cathodic areas, the attack is sometimes so severe and persistent that stray current interchange at aluminum-concrete interfaces should be carefully avoided.

4. Galvanic action of aluminum with more noble metals will not result in severe corrosion except when chlorides are present. With chloride present severe pitting will occur.

Recommendations for Future Study

To further define conditions in which aluminum would be incompatible with concrete, additional experimental work should be carried out. This should include:

1. Tests of the effect of sulphate ions on the protectiveness of the aluminate film. Since sulphate ions will attack concrete they may also destroy the protective nature of the aluminate films on the aluminum surface.

2. Additional tests of the effects of voids to determine the variables influencing current flow. Further refinement of the galvanic cells using smaller strips to facilitate resistance measurements should be incorporated in such tests. More accurate resistance measurements could reveal effects of galvanic current on the corrosion process.

3. Since aluminum cathodes were severely corroded in wet concrete, further tests should be made to study effects in dry concrete. Also, tests over periods of six months or longer should be carried out.

4. In general, the cladding used on aluminum is anodic to the base metal; therefore once the clad is penetrated, the base metal could feasibly suffer severe corrosion from the cathodic reaction products. This type of corrosion leads to severe pitting. Tests of Alclad alloys should be made to see if the galvanic current flow is significant.

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APPENDIX A

DERIVATION OF EQUATION FOR VOLUME LOSS FROM RESISTANCE CHANGE OF ALUMINUM STRIPS

For a wheatstone bridge

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

where: $R_1 = \rho\left(\frac{L - L'}{wt_o} + \frac{L'}{wt}\right) =$ Resistance of corroding end of strip at any time

$R_2 = \frac{L_e}{wt_o} =$ Resistance of coated end of strip

so

$$\frac{\rho\left(\frac{L - L'}{wt_o} + \frac{L'}{wt}\right)}{\frac{\rho L_e}{wt_o}} = \frac{R_3}{R_4}$$

solving for t gives

$$t = \frac{t_o L'}{L_e\left(\frac{R_1}{R_2} - \frac{L - L'}{L_e}\right)}$$

and

$$\Delta t = t_o - t$$

or

$$\Delta t = t_o\left[1 - \frac{L'}{L_e\left(\frac{R_1}{R_2} - \frac{L - L'}{L_e}\right)}\right]$$

For the potentiometer and decade box used

$$R_1 = R_p + R_{sw}r$$

$$R_2 = R_d + R'_{sw} - R_{sw}$$

Therefore

$$\Delta t = t_o\left[1 - \frac{L'}{L_e\left(\frac{R_p + R_{sw}r}{R_d + R'_{sw} - R_{sw}r} - \frac{L-L'}{L_e}\right)}\right]$$

substituting the numerical values for R_p, R_{sw}, and R'_{sw} gives

$$\Delta t = t_o\left[1 - \frac{L'}{L_e\left(\frac{80.2 + 5r}{R_d + 5.5 - 5r} - \frac{L-L'}{L_e}\right)}\right]$$

where: t_o = initial thickness

Δt = thickness of corroded area at any time

w = width of strip

ρ = resistivity of aluminum

L' = length of strip exposed to corrosion

L = length of corroding end of strip

L_e = length of coated end of strip

r = slidewire reading

R_d = resistance of decade box

R_p = resistance of potentiometer except for slidewire

R_{sw} = resistance of slidewire between $r = 0$ and $r = 1$

R'_{sw} = total resistance of slidewire

APPENDIX B

TABLE VIII

TYPICAL ANALYSIS OF ATLAS TYPE I

PORTLAND CEMENT USED IN EXPERIMENT

CHEMICAL, Percent	
Silica (SiO_2)	20.9
Alumina (Al_2O_3)	5.7
Ferric Oxide (Fe_2O_3)	3.2
Magnesia (MgO)	1.1
Calcium Oxide (CaO)	65.1
Sulphuric Anhydride (SO_3)	1.9
Ignition Loss	0.74
Potential Compounds	
Tricalcium Silicate	51.4
Dicalcium Silicate	24.0
Tricalcium Aluminate	9.8
PHYSICAL	
Fineness, Specific Surface (Wagner)	1756
Soundness, Autoclave Expansion	0.14
Time of Set (Gillmore)	
Initial (Hr. : Min.)	3:01
Final (Hr. : Min.)	6:00
Vicate	2:03
Compressive Strength, psi.	
3-day	2450
7-day	3880
28-day	5770

TABLE IX

CHEMICAL COMPOSITION LIMITS FOR

ALUMINUM ALLOYS USED IN EXPERIMENT

	5154 %	6061 %
Silicon	0.45 Si+Fe	0.4-0.8
Iron		0.7
Copper	0.10	0.15-0.40
Manganese	0.10	0.15
Magnesium	3.1 -3.9	0.8 -1.2
Chromium	0.15-0.35	0.15-0.35
Nickel	---	---
Zinc	0.20	0.25
Titanium	0.20	0.15
Other		
Each	0.05	0.5
Total	0.15	0.15
Aluminum	Remainder	Remainder

APPENDIX C

TABLE X

STATIC CORROSION TESTS OF 6061-T6 ALLOY IN CONCRETE

	Volume Loss ($in^3/in^3 \times 10^3$)			
Exposure Time (Days)	3	6	12	24
Admixture				
None	0.255 0.190	0.347 0.282	0.529 0.381	0.731 0.675
0.01 N NaOH	0.271 0.292	0.336 0.369	0.499 0.513	0.656 0.745
0.05 N NaOH	0.313 0.353	0.403 0.453	0.560 0.612	0.876 0.949
0.10 N NaOH	0.460 0.440	0.543 0.597	0.792 0.790	1.120 1.322
0.01 N $CaCl_2$	0.268 0.272	0.335 0.343	0.496 0.483	0.746 0.761
0.10 N $CaCl_2$	0.298 0.310	0.425 0.468	0.663 0.669	0.921 0.987
1.0 N $CaCl_2$	0.043 0.049	0.047 0.060	0.081 0.097	0.083 0.120
0.01 N $CaCl_2$-0.01 N NaOH	0.284 0.291	0.354 0.383	0.490 0.543	0.832 0.763
0.10 N $CaCl_2$-0.01 N NaOH	0.294 0.327	0.437 0.487	0.653 0.661	0.881 0.997
0.10 N $CaCl_2$-0.10 N NaOH	0.408 0.422	0.626 0.568	0.872 0.815	1.095 1.232
1.0 N $CaCl_2$-0.05 N NaOH	0.060 0.052	0.065 0.074	0.083 0.100	0.106 0.147
1.0 N $CaCl_2$-0.10 N NaOH	0.051 0.051	0.086 0.059	0.169 0.115	0.219 0.147

TABLE XI

CORROSION OF 5154-H34 ALLOY IN GALVANIC CELLS

Volume Losses of Aluminum ($in^3/in^2 \times 10^3$)

Admixture	pH	Cell No.	Cup	Strip[1]	Cell No.	Cup	Strip[2]	Cell No.	Cup	Strip[3]
None	12.5	D 20	0.437	1.426	E 14	0.625	0.793	E 1	0.443	1.148
		D 3	0.453	0.748	E 18	0.548	0.878	E 2	1.051	1.034
0.01 N NaOH	12.5	D 8	0.683	0.610	E 3	0.645	1.580	E 4	0.674	1.355
		D 2	0.597	1.115	E 15	0.487	1.436	E 7	0.656	1.979
0.05 N NaOH	12.5	D 21	0.780	4.471	E 22	0.932	1.876	E 13	0.850	1.528
		D 19	0.726	2.632	E 24	1.029	3.460	E 12	0.892	4.505
0.10 N NaOH	12.6	D 10	1.829	5.306						
		D 24	1.432	4.667						
0.01 N $CaCl_2$	12.5	D 16	0.423	0.898						
		D 1	1.172	0.876						
0.10 N $CaCl_2$	12.3	D 12	0.388	0.566	E 19	0.555	0.620	E 9	0.515	0.530
		D 5	0.595	0.598	E 23	0.514	0.656	E 11	0.394	0.674
1.0 N $CaCl_2$	12.0	D 18	0.074	0.224						
		D 17	0.069	0.270						
0.01 N $CaCl_2$-0.01 N NaOH	12.5	D 9	0.490	1.219	E 20	0.681	1.692	E 6	0.666	1.306
		D 22	0.622	0.934	E 21	0.658	1.202	D 10	0.588	1.281
0.10 N $CaCl_2$-0.01 N NaOH	12.4	D 15	0.448	0.936						
		D 7	0.549	0.604						
0.10 N $CaCl_2$-0.10 N NaOH	12.4	D 23	0.534	1.066	E 16	1.060	1.750	E 5	0.524	0.829
		D 6	0.853	2.418	E 17	0.880	2.231	E 8	0.729	1.166
1.0 N $CaCl_2$-0.05 N NaOH	11.9	D 4	0.074	0.192						
		D 14	0.066	0.227						
1.0 N $CaCl_2$-0.10 N NaOH	12.1	D 13	0.072	0.290						
		D 11	0.115	0.221						

[1] Exposed area of strip was 2 square inches.
[2] Exposed area of strip was 1.5 square inches.
[3] Exposed area of strip was 0.75 square inches.

TABLE XII

CORROSION OF 6061-T6 ALLOY IN GALVANIC CELLS

Volume Losses of Aluminum ($in^3/in^2 \times 10^3$)

Admixture	pH	Cell No.	Cup	Strip[1]	Cell No.	Cup	Strip[2]	Cell No.	Cup	Strip[3]
None	12.5	B 4	0.586	0.968	C 1	0.153	1.355	C 3	0.434	0.748
		B 6	1.264	1.230	C 9	0.529	0.703	C 8	0.467	0.865
0.01 N NaOH	12.5	B 19	0.269	1.805	C 6	0.681	1.449	C 13	0.551	1.301
		B 18		2.054	C 21	0.587	1.359	C 7	0.582	1.067
0.05 N NaOH	12.5	B 17	0.673	2.314	C 16	1.581	4.703	C 11	0.767	3.966
		B 24	0.804	2.102	C 22	0.643	4.678	C 19	0.511	1.732
0.10 N NaOH	12.6	B 11	0.720	8.091						
		B 20	0.549	9.991						
0.01 N $CaCl_2$	12.5	B 3	0.660	0.703						
		B 13	0.435	0.595						
0.10 N $CaCl_2$	12.3	B 22	1.435	0.510	C 12	0.361	0.730	C 5	0.311	0.620
		B 23	1.209	0.602	C 23	0.315	0.596	C 18	0.324	0.443
1.0 N $CaCl_2$	12.0	B 7	0.094							
		B 9		0.173						
0.01 N $CaCl_2$-0.01 N NaOH	12.5	B 14	0.581	0.737	C 2	0.508	1.234	C 20	0.446	1.013
		B 2	0.493	0.664	C 24	0.203	1.393	C 14	0.536	1.061
0.10 N $CaCl_2$-0.01 N NaOH	12.4	B 16	0.786	0.614						
		B 21		0.544						
0.10 N $CaCl_2$-0.10 N NaOH	12.4	B 5	1.544	1.249	C 10	0.940	1.400	C 15	0.614	1.656
		B 8	0.888	1.150	C 17	0.490	0.838	C 4	0.612	0.604
1.0 N $CaCl_2$-0.05 N NaOH	11.9	B 12	0.057	0.157						
		B 1	0.057	0.157						
1.0 N $CaCl_2$-0.10 N NaOH	12.1	B 15	0.068	0.184						

[1]Exposed area of strip was 2 square inches.
[2]Exposed area of strip was 1.5 square inches.
[3]Expoaed area of strip was 0.75 square inches.

TABLE XIII

EFFECT OF IMPRESSED CURRENT ON THE

CORROSION OF 6061-T6 ALUMINUM CATHODES

Volume Loss of Electrode ($in^3/in^2 \times 10^3$)

Admixture / Current Density ma/in^2	None	0.1N NaOH 0.1N $CaCl_2$	0.1N $CaCl_2$
		Twelve Day Test	
1.0	17.36	11.85	15.24
0.5	5.98	7.35	6.10
0.2	3.02	3.01	2.42
		Six Day Test	
1.0	7.22	5.63	8.56
0.5	2.10	4.09	3.08
0.2	0.69	1.46	0.51
		Three Day Test	
1.0	2.76	3.39	4.09
0.5	0.96	1.14	1.18
0.2	0.29	0.22	0.40

TABLE XIV

EFFECT OF IMPRESSED CURRENT ON THE CORROSION OF 6061-T6 ALUMINUM ANODES

Admixture	None	0.1N $CaCl_2$ 0.1N NaOH	0.1N $CaCl_2$
Current Density ma/in^2	Volume Loss (in^3/in^2 x 10^3)		
	Exposed 12 Days		
1.0	0.27		2.78
0.5		1.58	0.29
0.2	0.41	0.62	
	Exposed 6 Days		
1.0	0.49		1.26
0.5	0.15	0.65	0.76
0.2	0.24	0.85	0.65
	Exposed 3 Days		
1.0			0.79
0.5	0.12	0.339	
0.2	0.65		

TABLE XV

ANALYSIS OF VARIANCE OF STATIC

CORROSION TESTS IN CONCRETE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	95	8.8731	
Replicates	1	0.0102	
Treatment	47	8.7884	
Mixes	11	5.0705	0.4609
Days	3	2.9291	0.9764
Day x Mix	33	0.7889	0.0239
Error	47	0.0745	0.00158

$S_{\bar{x}} = 0.028 \text{ in}^3/\text{in}^2 \times 10^3$

$LSD_{95\%} = 0.080 \text{ in}^3/\text{in}^2 \times 10^3$

TABLE XVI

ANALYSIS OF VARIANCE FOR

ELECTROLYTIC CELLS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	26	527.118	
Days	2	192.624	96.312
Mix	2	0.596	0.298
Current Density	2	240.464	120.232
Current Density x Mix	4	11.391	0.889
Day x Mix	4	3.555	2.848
Day x current density	4	69.596	
Current density x mix x days	8	8.992	1.124

$S_{\bar{x}} = 1.06 \text{ in}^3/\text{in}^2 \times 10^3$

$LSD_{95\%} = 3.45 \text{ in}^3/\text{in}^2 \times 10^3$

TABLE XVII

ANALYSIS OF VARIANCE FOR GALVANIC

CELLS TESTING MIX AND AREA

Analysis For Strips

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	47	184.8901	
Replicate	1	0.0000	
Treatment	23	179.7043	
Mix	11	159.7755	14.5250
Alloy	1	0.4105	0.4105
Mix Alloy	11	19.5183	1.7744
Error	23	5.1858	0.2255

$S_{\bar{x}} = 0.336 \ in^3/in^2 \times 10^3$

$LSD_{95\%} = 1.14 \ in^3/in^2 \times 10^3$

Analysis For Cups

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares
Total	47	8.8805	
Replicates	1	0.0124	
Treatment	23	7.8245	
Mix	11	5.4786	0.4981
Alloy	1	0.0310	0.0310
Mix x Alloy	11	2.3149	0.2104
Error	23	0.9716	0.0422

$S_{\bar{x}} = 0.145 \ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.416 \ in^3/in^2 \times 10^3$

TABLE XVIII

ANALYSIS OF VARIANCE FOR GALVANIC CELLS

TESTING MIX, AREA, AND ALLOY

Analysis For Strips

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	71	71.8562	
Replicates	1	0.0006	
Treatment	35	65.3356	
Mix	5	47.7543	9.5509
Alloy	1	0.0809	0.0809
Area	2	0.9510	0.4755
Alloy x Area	2	0.5890	0.2945
Alloy x Mix	5	0.8065	0.1613
Mix x Area	10	1.9852	0.9926
Mix x Area x Alloy	10	13.1686	1.3169
Error	35	6.5200	0.1863

$S_{\bar{x}} = 0.305\ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.873\ in^3/in^2 \times 10^3$

Analysis For Cups

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	71	5.6283	
Replicates	1	0.0058	
Treatments	35	4.0675	
Mix	5	1.2421	0.2484
Alloy	1	0.0015	0.0015
Area	2	0.2286	0.1143
Alloy x Area	2	0.6523	0.3262
Alloy x Mix	5	0.0558	0.0112
Mix x Area	10	0.8732	0.0873
Mix x Area x Alloy	10	1.0140	0.1014
Error	35	1.5550	0.0444

$S_{\bar{x}} = 0.227\ in^3/in^2 \times 10^3$

$LSD_{95\%} = 0.652\ in^3/in^2 \times 10^3$

TABLE XIX

CURRENT-TIME VALUES FROM GALVANIC CELLS FOR 6061-T6 ALLOY

Admixture None				Admixture 0.01 N NaOH			
Cell No. B 4		Cell No. B 6		Cell No. B 24		Cell No. B 19	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.007	0.0	-0.010	0.0	0.015	0.0	-0.001
0.3	-0.088	1.8	0.006	1.0	0.085	1.0	0.019
0.5	-0.142	3.0	0.000	2.3	0.056	1.2	0.013
0.6	-0.088	5.0	-0.016	4.2	0.071	1.6	0.006
1.0	-0.116	10.5	-0.015	6.0	0.080	2.2	0.000
2.3	0.100	14.8	-0.014	8.5	-0.016	2.8	-0.004
2.8	0.090	19.5	-0.109	9.8	-0.010	3.3	-0.007
3.2	0.077	34.5	-0.030	12.5	-0.177	4.0	-0.024
4.3	0.044	42.5	0.174	16.0	-0.273	5.0	-0.044
5.0	0.023	58.7	0.377	34.0	0.082	5.5	-0.040
5.8	-0.014	64.5	0.394	41.8	0.247	7.1	-0.023
6.3	-0.038	70.0	0.392	45.0	0.286	8.7	-0.057
6.8	-0.047	85.5	0.339	63.0	0.387	11.0	-0.025
8.2	-0.030	93.5	0.200	80.8	0.416	13.0	-0.036
9.0	-0.059	116.5	0.253	84.8	0.430	15.3	-0.011
10.5	-0.068	130.3	0.254	92.9	0.429	16.8	-0.026
12.3	-0.048	141.8	0.239	106.5	0.416	18.4	-0.175
15.4	-0.800	152.8	0.219	116.0	0.422	20.8	-0.194
16.5	-0.066	159.2	0.234	129.5	0.412	25.5	-0.138
18.0	-0.082	177.5	0.221	141.0	0.471	40.1	0.163
19.0	-0.104	200.2	0.210	158.3	0.413	51.5	0.336
22.0	-0.082	211.5	0.195	176.8	0.391	70.8	0.386
26.5	-0.075	236.8	0.169	186.3	0.422	87.7	0.370
41.0	0.133	274.8	0.160	200.0	0.393	96.0	0.394
46.6	0.193	273.5	0.145	210.8	0.416	99.8	0.434
53.0	0.240	286.2	0.137	236.3	0.404	123.0	0.348
72.0	0.260	309.8	0.133	274.3	0.395	141.0	0.322
76.3	0.285	320.8	0.125	260.5	0.204	159.3	0.303
89.0	0.236	343.5	0.120	273.0	0.382	172.5	0.300
97.5	0.239	357.3	0.117	285.5	0.399	193.3	0.326
114.5	0.216	373.0	0.110	295.3	0.364	217.8	0.332
137.5	0.198	380.5	0.115	309.3	0.384	243.3	0.310
160.0	0.170	397.0	0.111	333.5	0.361	254.5	0.286
184.8	0.152	404.0	0.120	343.0	0.354	280.0	0.264
235.5	0.122	415.7	0.122	356.5	0.358	302.5	0.257
255.3	0.107	441.0	0.118	373.5	0.342	340.5	0.254
281.0	0.095	453.5	0.116	403.5	0.328	387.0	0.259
328.0	0.078	463.5	0.117	440.5	0.296	410.5	0.256
381.5	0.075	478.0	0.119	453.0	0.296	447.5	0.250
448.5	0.069	488.5	0.113	487.0	0.280	494.0	0.259
509.5	0.073	500.0	0.113	511.3	0.270	518.3	0.274
530.5	0.075	523.0	0.114	522.8	0.273	529.8	0.272

TABLE XIX (continued)

Admixture 0.05 N NaOH				Admixture 0.10 N NaOH			
Cell No. B 18		Cell No. B 17		Cell No. B 11		Cell No. B 20	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.010	0.0	-0.000	0.0	0.025	0.0	0.008
0.9	0.013	0.2	0.078	0.3	0.227	0.4	0.104
2.1	0.029	0.7	0.061	0.9	0.156	1.6	0.171
5.3	0.001	1.5	0.053	1.5	0.151	2.9	-0.471
9.0	-0.011	2.2	0.042	2.2	0.229	3.7	-0.303
12.0	-0.012	2.8	0.018	3.0	0.162	5.0	0.419
15.1	0.044	3.5	-0.000	3.7	0.005	6.0	0.087
32.5	0.263	4.5	-0.031	4.7	0.034	7.3	0.444
41.0	0.433	5.8	-0.031	6.3	-0.043	10.2	0.606
57.2	0.484	7.5	0.099	7.7	-0.289	11.4	0.875
67.4	0.471	8.8	0.122	9.4	0.012	13.5	0.664
80.0	0.471	10.5	-0.011	14.0	0.736	16.2	0.554
88.3	0.450	12.6	-0.080	38.5	0.449	32.7	0.585
106.0	0.187	19.1	-0.029	47.2	0.566	36.9	0.726
129.0	0.352	21.9	0.035	63.3	0.446	40.2	0.804
140.3	0.345	39.5	0.330	75.5	0.509	42.3	0.855
157.6	0.331	48.0	0.435	80.0	0.558	56.0	0.897
176.0	0.321	64.0	0.487	88.0	0.736	62.3	0.928
199.0	0.286	74.5	0.521	102.0	0.682	66.5	0.906
228.0	0.427	87.0	0.522	111.0	0.729	79.0	0.883
244.5	0.256	95.5	0.518	129.3	0.697	83.0	0.886
260.0	0.256	113.0	0.535	136.5	0.616	86.5	0.849
272.0	0.246	135.8	0.532	147.5	0.658	91.0	0.833
294.5	0.246	147.5	0.531	161.0	0.650	104.8	0.960
308.5	0.272	158.5	0.510	172.0	0.704	114.4	0.939
332.5	0.309	171.7	0.505	195.3	0.645	128.0	0.908
342.0	0.303	193.0	0.484	206.0	0.790	132.5	0.912
355.5	0.303	217.0	0.387	237.0	0.666	139.5	0.903
379.0	0.319	243.0	0.271	242.5	0.531	150.4	0.907
395.5	0.326	254.5	0.243	268.0	0.552	156.9	0.923
402.5	0.326	266.5	0.245	280.5	0.579	175.0	0.934
414.3	0.328	301.3	0.197	304.3	0.578	185.0	0.919
439.8	0.331	313.0	0.230	328.5	0.562	198.0	0.905
452.0	0.319	326.3	0.310	338.0	0.559	209.0	0.950
476.5	0.346	379.5	0.383	368.5	0.545	227.0	0.446
502.0	0.324	402.5	0.329	391.5	0.549		
522.0	0.317	421.8	0.370	435.8	0.513		
		437.3	0.360	458.0	0.508		
		459.5	0.350	472.5	0.511		
		475.5	0.364	496.5	0.499		
		498.0	0.350	506.5	0.498		
		519.5	0.376	518.0	0.494		

TABLE XIX (continued)

Admixture 0.01 N $CaCl_2$				Admixture 0.10 N $CaCl_2$			
Cell No. B 3		Cell No. B 13		Cell No. B 23		Cell No. B 22	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.008	0.0	-0.012	0.0	-0.051	0.0	-0.020
0.3	0.017	1.3	0.053	1.7	-0.014	0.6	0.004
0.9	0.093	3.3	0.010	4.6	-0.016	2.3	0.022
1.3	0.065	4.7	0.014	8.7	-0.079	3.5	-0.002
2.3	0.073	5.5	-0.028	10.0	-0.094	5.3	-0.037
3.3	0.042	6.0	-0.005	14.8	-0.126	6.6	-0.066
4.1	-0.019	9.7	-0.080	29.3	0.067	7.2	-0.073
5.8	-0.034	13.0	0.034	34.5	0.096	8.4	-0.003
7.0	-0.034	30.4	0.003	40.8	0.119	10.4	0.139
8.8	-0.028	35.7	0.028	54.0	0.133	12.8	-0.062
13.2	0.039	41.9	0.004	64.3	0.117	14.0	-0.044
14.5	0.041	61.0	0.067	76.5	0.089	18.2	-0.091
18.6	-0.032	65.3	0.065	85.2	0.119	20.3	-0.132
20.6	0.048	82.0	0.050	89.0	0.075	23.0	-0.127
38.0	0.037	90.0	0.040	102.7	0.056	37.5	-0.186
48.5	0.054	103.8	0.022	112.0	0.050	42.8	-0.157
62.6	0.069	113.0	0.012	130.0	0.038	46.0	-0.134
72.8	0.083	126.8	0.006	148.0	0.030	62.2	-0.038
85.5	0.077	138.3	-0.013	154.3	0.028	72.5	-0.032
93.9	0.076	155.3	-0.025	172.8	0.019	89.0	-0.036
111.3	0.065	173.9	-0.040	182.3	0.017	97.0	-0.046
120.5	0.056	197.0	-0.055	206.8	0.006	110.3	-0.069
134.8	0.033	225.7	-0.071	224.5	-0.006	120.0	-0.083
145.8	0.055	233.3	-0.071	243.3	-0.012	133.8	-0.094
156.8	0.037	257.7	-0.068	269.0	-0.016	138.3	-0.097
170.0	0.020	282.5	-0.066	291.3	-0.018	162.7	-0.103
181.5	0.023	292.3	-0.063	316.0	-0.018	180.8	-0.107
191.0	0.017	306.3	-0.059	329.5	-0.017	194.2	-0.112
215.5	0.009	317.3	-0.056	352.5	-0.018	205.0	-0.121
233.2	0.006	330.5	-0.053	369.5	-0.020	230.5	-0.116
253.0	0.002	340.0	-0.052	376.0	-0.022	254.8	-0.122
278.5	0.009	353.5	-0.048	392.5	-0.023	279.7	-0.125
300.8	0.013	370.5	-0.049	399.5	-0.024	303.3	-0.118
325.8	-0.008	377.0	-0.044	411.3	-0.028	327.5	-0.114
339.0	-0.013	393.5	-0.042	436.5	-0.034	350.5	-0.112
362.0	-0.015	400.5	-0.043	449.0	-0.034	390.5	-0.106
379.0	-0.023	437.8	-0.039	473.3	-0.045	447.0	-0.101
385.5	-0.019	450.0	-0.039	497.5	-0.040	482.0	-0.093
409.0	-0.017	474.3	-0.040	507.3	-0.042	505.5	-0.090
446.8	-0.012	498.5	-0.026	518.5	-0.044	517.0	-0.092
493.5	-0.007	520.0	-0.022				
528.5	-0.005						

TABLE XIX (continued)

Admixture 1.0 N $CaCl_2$				Admixture 0.01 N $CaCl_2$-0.01 N NaOH			
Cell No. B 9		Cell No. B 7		Cell No. B 2		Cell No. B 14	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.352	0.0	-0.034	0.0	-0.004	0.0	-0.014
0.8	0.121	0.8	0.074	0.7	0.322	0.3	0.013
1.3	0.103	1.2	0.059	1.3	0.202	1.3	0.042
2.9	0.230	2.3	0.000	3.6	0.025	2.7	0.021
3.8	0.275	3.0	-0.004	4.8	0.004	4.3	0.000
4.5	0.280	4.8	0.029	7.7	-0.019	5.5	-0.027
7.8	0.097	6.0	0.076	11.0	-0.024	7.5	-0.058
9.2	-0.001	7.8	0.134	13.8	-0.074	11.8	-0.016
11.2	-0.124	12.2	-0.220	28.3	-0.088	13.1	-0.030
13.0	-0.224	13.5	-0.229	37.0	-0.011	17.3	-0.104
28.5	-0.076	17.5	-0.428	39.8	0.012	22.0	-0.152
37.0	0.001	19.5	-0.253	53.0	0.044	36.3	0.020
53.0	0.018	37.3	-0.434	63.3	0.056	45.0	0.122
59.0	0.018	48.2	-0.293	76.0	0.042	61.3	0.153
63.3	0.019	67.5	-0.198	80.0	0.058	67.0	0.154
76.0	0.014	84.4	-0.153	84.3	0.064	84.0	0.122
84.3	0.010	88.4	-0.147	101.7	0.034	92.5	0.113
88.0	0.011	96.5	-0.146	124.7	0.012	109.8	0.079
101.9	0.008	110.3	-0.125	129.0	0.011	132.8	0.034
125.0	0.004	119.5	-0.119	147.3	0.002	144.3	0.024
129.0	0.005	133.8	-0.103	153.3	0.004	155.5	0.009
136.0	0.003	144.8	-0.087	171.8	0.010	168.8	-0.000
147.3	0.002	155.8	-0.079	195.0	0.014	180.0	-0.017
153.3	0.002	169.0	-0.084	205.8	0.010	190.5	-0.028
160.5	0.002	180.3	-0.082	223.5	0.004	203.3	-0.039
171.8	0.001	190.0	-0.082	231.5	0.000	231.0	-0.060
195.0	0.001	203.5	-0.072	255.5	0.000	248.6	-0.068
205.8	0.002	214.5	-0.074	268.0	0.000	263.8	-0.077
231.3	0.000	232.2	-0.069	285.0	0.000	288.5	-0.088
242.3	0.000	251.0	-0.063	290.3	0.000	298.3	-0.088
255.5	0.000	264.2	-0.063	304.5	0.000	336.5	-0.091
280.5	0.001	289.0	-0.066	315.1	0.003	360.0	-0.082
290.3	0.001	299.0	-0.059	328.5	0.009	382.0	-0.080
315.0	0.001	323.8	-0.061	351.5	0.010	399.5	-0.074
338.0	0.001	346.5	-0.060	368.5	0.009	406.5	-0.075
368.5	0.000	377.0	-0.062	391.5	0.008	418.3	-0.081
391.5	0.000	401.0	-0.061	398.5	0.008	446.0	-0.066
435.5	0.000	418.8	-0.066	435.5	0.012	470.5	-0.062
517.7	0.000	444.0	-0.005	448.5	0.010	494.5	-0.058
		466.5	-0.071	458.0	0.012	504.5	-0.054
		480.8	-0.079	496.5	0.015		
		505.0	-0.069	517.7	0.016		
		526.0	-0.081				

TABLE XIX (continued)

Admixture 0.10 N $CaCl_2$-0.01 N NaOH				Admixture 0.1 N $CaCl_2$-0.1 N NaOH			
Cell No. B 21		Cell No. B 16		Cell No. B 8		Cell No. B 5	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.009	0.0	-0.003	0.0	0.017	0.0	0.000
0.5	0.110	0.8	0.047	0.4	0.083	0.8	0.099
2.0	0.343	1.3	0.061	1.9	0.056	2.3	0.025
4.0	0.394	3.8	0.030	4.0	-0.007	3.2	-0.020
7.0	-0.032	4.5	-0.009	7.0	0.002	4.0	-0.054
10.3	-0.059	5.5	-0.068	10.3	0.030	4.5	-0.030
13.0	-0.049	6.8	-0.111	13.0	0.033	6.3	-0.068
27.6	0.074	8.8	-0.097	27.5	-0.063	10.7	-0.026
32.9	0.082	12.2	-0.068	36.0	-0.100	15.3	-0.123
36.1	0.080	16.5	-0.200	52.0	0.061	18.0	-0.062
52.3	0.097	18.5	-0.183	62.4	-0.023	35.3	-0.094
58.3	0.096	21.3	-0.203	75.0	-0.010	40.8	-0.025
75.0	0.051	35.8	0.122	87.0	0.203	47.0	0.033
83.5	0.025	44.5	0.240	98.8	0.233	60.2	0.080
101.1	0.018	46.5	0.246	110.0	0.268	70.3	0.103
110.3	-0.036	66.5	0.205	123.8	0.287	83.0	0.125
123.9	-0.059	83.3	0.133	135.3	0.116	91.3	0.157
135.8	0.060	91.8	0.381	146.3	0.144	108.8	0.050
146.8	0.073	109.2	0.284	159.6	0.293	118.0	0.132
171.3	-0.085	118.5	0.018	171.0	0.299	131.7	0.123
194.5	-0.089	132.2	0.060	180.5	0.295	143.3	0.128
223.0	-0.097	143.8	0.181	194.2	0.348	160.5	0.145
231.0	-0.102	161.0	-0.086	205.2	0.203	178.9	0.110
242.0	-0.000	168.0	-0.088	222.7	0.152	188.5	0.129
255.0	-0.000	188.8	-0.084	230.3	0.111	202.0	0.115
267.5	-0.087	213.3	-0.096	254.5	0.135	212.8	0.117
280.0	-0.082	231.0	-0.092	267.0	0.111	230.6	0.116
289.8	-0.086	249.8	-0.078	279.7	0.101	249.3	0.100
303.8	-0.093	263.0	-0.080	289.3	0.352	262.5	0.105
314.8	-0.087	275.5	-0.082	303.5	0.342	272.5	0.960
337.5	-0.079	288.0	-0.084	327.5	0.366	287.5	0.107
351.0	-0.077	296.8	-0.079	374.0	0.403	295.3	0.090
368.0	-0.072	311.8	-0.075	387.5	0.385	311.5	0.076
391.0	-0.067	322.8	-0.072	406.1	0.370	322.3	0.075
398.0	-0.066	345.5	-0.064	444.0	0.447	335.5	0.083
409.8	-0.068	382.5	-0.059	468.5	0.410	345.0	0.078
435.3	-0.000	399.0	-0.054	479.0	0.371	398.5	0.096
447.5	-0.000	443.3	-0.046	492.5	0.380	455.0	0.108
457.5	-0.058	465.5	-0.044	502.5	0.348	479.3	0.097
471.8	-0.064	489.5	-0.040	514.0	0.381	490.0	0.106
495.5	-0.056	513.8	-0.034			513.3	0.108
505.8	-0.053	525.3	-0.030			524.5	0.106
517.3	-0.058						

TABLE XIX (continued)

Admixture 1.0 N $CaCl_2$-0.05 N NaOH				Admixture 1.0 N $CaCl_2$-0.10 N NaOH			
Cell No. B 1		Cell No. B 12		Cell No. B 15		Cell No. B 10	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.064	0.0	0.069	0.0	0.077	0.0	0.030
0.3	-0.036	6.5	0.200	1.0	0.042	1.3	0.032
1.0	0.013	7.8	0.311	1.8	0.050	2.8	0.085
1.8	0.049	9.8	0.216	3.1	0.114	4.0	0.112
3.3	0.194	12.6	0.372	5.8	0.270	5.3	0.108
4.5	0.329	32.4	0.084	7.3	0.164	7.2	0.046
7.7	0.428	38.5	0.073	9.3	0.043	9.6	0.004
10.1	0.316	51.8	0.040	12.0	0.660	10.8	-0.016
11.3	0.263	62.1	0.026	26.0	0.024	15.0	-0.000
14.2	0.116	74.7	0.012	35.0	0.078	17.0	0.016
15.5	0.058	83.0	0.004	51.3	0.060	19.8	0.017
17.5	0.000	86.7	0.000	61.5	0.052	34.3	0.078
34.8	-0.101	109.8	0.010	74.0	0.040	42.8	0.042
40.0	-0.061	123.4	0.011	82.4	0.032	59.0	0.014
44.4	-0.043	127.8	0.009	86.0	0.027	64.0	0.006
59.5	-0.013	135.0	0.006	109.3	0.017	69.3	0.003
69.8	-0.014	146.0	-0.004	122.8	0.012	81.8	0.005
82.3	-0.017	159.3	-0.001	127.3	0.011	86.0	-0.006
86.5	-0.018	170.7	-0.000	134.4	0.010	90.2	-0.010
94.5	-0.023	180.3	0.002	145.3	0.006	107.7	-0.010
117.5	-0.026	193.8	0.003	158.7	0.006	117.0	-0.018
135.5	-0.024	204.5	0.002	179.5	0.006	130.5	-0.016
150.9	-0.018	222.4	0.003	204.5	0.006	141.1	-0.015
167.0	-0.016	230.0	0.003	229.8	0.005	159.3	-0.012
178.3	-0.012	241.5	0.004	240.8	0.006	177.8	-0.012
201.5	-0.006	234.5	0.003	266.5	0.006	201.0	-0.007
212.3	-0.006	267.0	0.004	279.0	0.004	229.5	-0.006
237.8	-0.003	279.5	0.004	288.8	0.004	248.3	-0.004
248.8	-0.004	289.3	0.005	302.8	0.004	261.5	-0.004
262.0	-0.002	303.3	0.005	314.0	0.004	274.0	-0.003
287.0	0.000	314.3	0.006	336.5	0.004	286.5	-0.005
296.8	0.000	327.5	0.005	350.0	0.004	296.3	-0.003
321.6	0.000	337.0	0.005	367.0	0.004	321.1	-0.004
405.0	0.000	367.5	0.006	373.5	0.004	334.5	-0.004
442.0	0.001	390.5	0.006	387.0	0.003	344.0	-0.003
464.5	0.001	409.3	0.006	397.0	0.004	364.5	-0.002
488.5	0.000	447.0	0.005	408.5	0.004	404.5	-0.002
503.0	0.000	471.3	0.003	434.0	0.000	454.0	-0.003
524.0	0.000	481.0	0.006	446.5	0.001	478.3	-0.005
		495.5	0.004	456.5	0.001	502.0	-0.004
		505.3	0.007	470.8	0.002	523.5	-0.005
		517.0	0.001	480.5	0.004		
				495.0	0.004		
				504.8	0.004		
				516.0	0.002		

TABLE XX

CURRENT-TIME VALUES FROM GALVANIC CELLS FOR 6061-T6 ALLOY

Admixture None				Admixture None			
Cell No. C 1		Cell No. C 9		Cell No. C 3		Cell No. C 8	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.041	0.0	-0.107	0.0	0.012	0.0	0.045
0.6	0.012	1.2	-0.148	0.5	-0.080	0.9	0.162
1.3	0.012	2.2	-0.001	0.7	-0.101	2.1	0.124
2.2	0.008	4.2	-0.017	1.5	-0.080	3.0	0.039
2.9	-0.015	4.2	-0.020	2.8	-0.044	4.1	0.002
3.3	0.001	5.9	-0.003	3.8	-0.028	5.0	0.004
4.3	0.007	7.0	-0.019	5.2	0.002	6.0	0.016
6.5	0.019	8.3	0.030	7.2	0.070	8.0	0.030
8.5	0.035	16.7	0.005	8.4	0.078	16.7	0.006
10.3	0.014	20.5	-0.023	10.3	0.051	20.5	0.004
12.6	-0.051	26.9	-0.076	12.5	0.052	24.0	-0.014
21.0	-0.061	30.5	-0.088	21.0	0.079	30.5	-0.026
27.8	-0.315	41.8	-0.101	24.8	0.058	41.7	-0.015
31.1	-0.235	47.7	-0.101	31.2	0.007	47.7	-0.014
34.8	-0.215	51.0	-0.095	34.7	-0.015	51.0	-0.013
45.9	-0.251	55.2	-0.089	52.0	-0.043	55.2	-0.017
55.3	-0.298	66.0	-0.069	55.3	-0.041	66.0	-0.026
59.5	-0.305	81.2	-0.070	61.1	-0.037	72.2	-0.028
61.1	-0.305	89.7	-0.071	70.3	-0.038	81.2	-0.058
70.3	-0.293	104.5	-0.067	85.5	-0.029	89.7	-0.054
85.5	-0.263	113.9	-0.052	94.0	-0.024	104.6	-0.057
108.9	-0.224	127.3	-0.051	108.9	-0.032	113.8	-0.049
118.2	-0.209	138.0	-0.042	118.3	-0.030	127.4	-0.037
121.6	-0.194	149.1	-0.034	131.7	-0.024	137.9	-0.037
132.1	-0.188	163.0	-0.022	141.2	-0.022	149.1	-0.033
143.4	-0.178	188.7	-0.011	153.3	-0.021	162.9	-0.030
167.3	-0.170	200.7	-0.004	167.2	-0.019	188.7	-0.012
193.0	-0.148	209.8	-0.001	193.0	-0.011	200.8	-0.006
204.9	-0.139	224.0	-0.002	205.1	-0.004	209.9	-0.006
214.1	-0.135	234.9	-0.007	214.2	-0.004	224.0	-0.000
228.3	-0.135	258.0	-0.013	228.3	0.004	234.9	0.006
239.2	-0.126	281.9	0.019	239.1	0.003	258.0	0.008
262.3	-0.106	304.2	0.021	262.3	0.006	281.9	0.016
286.2	-0.101	341.0	0.027	286.1	0.009	306.0	0.018
310.4	-0.091	362.9	0.026	310.4	0.008	341.2	0.025
345.4	-0.086	379.0	0.041	345.3	0.013	362.9	0.026
367.1	-0.081	401.6	0.027	368.2	0.017	389.0	0.026
405.9	-0.081	426.3	0.029	383.2	0.020	401.6	0.028
430.6	-0.078	449.8	0.030	430.5	0.020	426.2	0.030
454.1	-0.077	473.8	0.031	454.0	0.019	449.7	0.028
478.1	-0.077			478.0	0.020	473.7	0.033

TABLE XX (continued)

Admixture 0.05 N NaOH				Admixture 0.05 N NaOH			
Cell No. C 22		Cell No. C 16		Cell No. C 19		Cell No. C 12	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.001	0.0	-0.011	0.0	-0.012	0.0	-0.016
0.5	0.004	0.7	-0.053	0.6	-0.060	1.0	0.014
1.7	0.031	1.1	-0.027	1.8	0.078	1.9	0.102
2.5	0.044	1.8	-0.012	2.7	0.118	3.0	0.139
3.8	0.058	2.5	-0.011	4.8	0.156	4.9	0.123
4.7	0.035	3.5	0.114	6.7	0.190	6.1	0.073
5.5	0.042	6.1	0.235	8.0	0.250	8.2	0.262
6.7	0.062	7.0	0.137	20.2	0.220	9.1	0.103
8.0	0.096	9.0	0.240	23.9	0.207	10.0	0.116
16.3	0.300	10.0	0.319	26.6	0.173	12.3	0.078
23.4	0.396	12.2	0.392	30.2	0.124	20.7	0.200
26.3	0.375	20.6	0.508	41.5	0.024	24.5	0.106
30.0	0.233	28.1	0.413	47.5	0.005	30.9	0.030
41.2	-0.110	34.4	0.294	50.7	-0.019	34.5	0.075
50.5	-0.224	15.6	0.220	55.0	-0.023	45.7	-0.142
54.8	-0.258	54.9	0.177	56.5	-0.030	31.7	-0.162
65.5	-0.326	59.2	0.195	65.7	-0.034	59.2	-0.190
71.9	-0.335	60.7	0.186	72.1	-0.043	70.0	-0.201
80.7	-0.369	69.9	0.165	81.0	-0.044	76.3	-0.196
89.2	-0.420	85.1	0.170	89.5	-0.048	85.0	-0.190
104.2	-0.514	93.6	0.156	104.4	-0.043	94.7	-0.214
113.3	-0.530	108.5	0.157	113.5	-0.040	108.6	-0.220
127.0	-0.434	117.8	0.158	127.2	-0.036	117.8	-0.193
148.7	-0.440	131.3	0.162	137.7	-0.030	131.4	-0.196
162.5	-0.450	142.9	0.149	148.9	-0.033	141.9	-0.208
188.3	-0.443	153.0	0.153	162.7	-0.030	153.1	-0.190
200.3	-0.448	167.8	0.141	188.5	-0.026	166.9	-0.196
209.5	-0.450	192.6	0.158	200.5	-0.022	192.7	-0.186
223.5	-0.445	204.7	0.151	209.6	-0.026	213.9	-0.190
233.9	-0.440	213.8	0.145	223.8	-0.020	238.8	-0.187
257.5	-0.425	227.9	0.148	234.5	-0.022	262.0	-0.188
291.3	-0.411	238.8	0.130	257.7	-0.016	285.9	-0.189
305.6	-0.423	261.9	0.128	281.6	-0.008	310.1	-0.194
340.7	-0.400	286.2	0.126	305.9	-0.011	345.1	-0.196
362.5	-0.388	310.0	0.077	341.0	-0.008	366.9	-0.196
378.5	-0.386	345.0	0.033	362.7	-0.002	382.9	-0.206
401.0	-0.384	366.8	0.020	378.7	-0.003	405.5	-0.202
425.7	-0.370	382.9	0.019	401.3	-0.000	430.2	-0.204
449.3	-0.355	405.5	0.009	426.0	-0.005	453.8	-0.204
473.3	-0.347	430.2	0.000	449.5	-0.004	477.7	-0.204
		453.7	0.005	473.5	-0.006		
		477.7	0.009				

TABLE XX (continued)

Admixture 0.01 NaOH				Admixture 0.01 NaOH			
Cell No. C 21		Cell No. C 6		Cell No. C 13		Cell No. C 7	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.046	0.0	-0.021	0.0	0.011	0.0	-0.020
0.1	-0.190	0.6	-0.111	0.3	0.015	0.5	-0.010
1.3	-0.038	1.1	-0.081	1.2	-0.004	1.7	-0.033
2.1	-0.020	2.2	-0.035	1.8	0.000	2.5	-0.038
3.3	-0.036	2.8	-0.014	2.3	-0.005	4.5	-0.001
4.3	-0.044	4.2	0.035	4.3	-0.014	5.4	-0.014
6.2	-0.006	6.3	0.049	6.3	0.006	6.5	0.021
7.3	0.000	8.3	0.159	7.5	0.018	7.8	0.046
15.9	0.134	9.2	0.149	9.2	0.060	16.3	0.022
19.7	0.114	10.3	0.171	11.6	0.086	20.0	0.002
23.4	0.096	11.5	0.154	20.0	-0.040	26.3	-0.045
29.7	0.052	19.9	0.229	23.8	-0.090	41.3	-0.062
40.9	-0.068	23.8	0.195	27.5	-0.112	50.5	-0.058
50.2	-0.130	30.1	0.117	33.8	-0.126	54.7	-0.064
54.6	-0.145	33.7	0.072	51.0	-0.126	65.5	-0.062
56.0	-0.150	44.9	-0.082	54.3	-0.126	80.7	-0.068
65.2	-0.160	54.2	-0.162	58.5	-0.121	89.1	-0.072
71.6	-0.160	60.0	-0.182	60.1	-0.122	113.3	-0.061
80.3	-0.153	75.6	-0.232	69.3	-0.111	126.8	-0.059
88.9	-0.157	84.4	-0.191	84.5	-0.116	137.4	-0.051
103.9	-0.153	92.9	-0.191	93.0	-0.115	148.6	-0.047
113.0	-0.149	107.9	-0.181	108.0	-0.113	162.4	-0.042
126.7	-0.159	130.6	-0.172	117.2	-0.108	188.2	-0.037
137.2	-0.146	141.2	0.173	130.7	-0.097	200.3	-0.035
148.4	-0.142	152.4	-0.163	141.3	-0.095	209.4	-0.034
162.2	-0.137	166.2	-0.156	152.5	-0.084	223.4	-0.031
188.0	-0.132	192.0	-0.150	166.2	-0.083	141.7	-0.018
200.0	-0.125	204.0	-0.149	192.0	-0.067	152.9	-0.006
209.1	-0.123	213.1	-0.148	204.1	-0.062	166.7	0.006
223.3	-0.125	227.2	-0.147	227.3	-0.055	192.3	0.034
233.6	-0.119	238.1	-0.135	261.3	-0.042	204.5	0.041
257.2	-0.108	261.2	-0.131	285.2	-0.039	213.6	0.044
281.0	-0.102	285.1	-0.132	309.3	-0.035	227.7	0.049
305.4	-0.098	309.4	-0.120	334.4	-0.027	238.7	0.048
340.4	-0.096	344.4	-0.119	366.2	-0.021	261.8	0.048
372.1	-0.096	366.1	-0.122	392.4	-0.019	309.9	0.046
370.2	-0.092	382.3	-0.119	405.0	-0.018	344.9	0.048
400.8	-0.094	404.9	-0.117	429.6	-0.011	302.8	0.042
425.4	-0.096	429.5	-0.116	453.1	-0.011	405.3	0.044
449.0	-0.096	453.0	-0.110	477.1	-0.010	430.0	0.040
473.0	-0.098	477.0	-0.101			453.5	0.038
						477.5	0.039

TABLE XX (continued)

Admixture 0.10 N $CaCl_2$				Admixture 0.10 N $CaCl_2$			
Cell No. C 23		Cell No. C 12		Cell No. C 5		Cell No. C 18	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.005	0.0	0.006	0.0	0.006	0.0	0.046
0.8	-0.148	0.6	-0.101	0.3	0.022	0.5	-0.038
1.9	-0.120	0.9	-0.083	1.0	-0.050	1.8	0.012
4.0	-0.038	1.6	-0.053	2.6	-0.016	2.5	0.028
4.8	-0.023	2.3	-0.026	3.1	-0.026	4.8	0.046
5.6	-0.000	2.8	-0.017	4.6	-0.013	6.7	0.086
6.7	0.021	3.3	-0.008	5.8	-0.008	7.9	0.101
8.0	0.114	4.8	0.030	7.8	0.023	20.0	0.028
16.4	0.219	6.0	0.061	8.7	0.048	23.8	-0.010
20.3	0.157	6.9	-0.034	9.6	0.068	26.5	-0.029
23.8	0.099	8.0	0.180	10.9	0.049	30.1	-0.051
26.6	0.058	8.9	0.178	20.3	0.067	41.3	-0.042
30.2	0.024	9.7	0.129	27.8	0.000	47.3	-0.033
40.5	-0.063	9.8	0.056	30.7	-0.016	50.6	-0.029
50.7	-0.106	12.1	0.028	45.3	-0.047	54.8	-0.026
56.5	-0.116	20.5	0.050	54.6	-0.048	56.4	-0.026
65.7	-0.101	24.3	0.032	60.4	-0.050	65.6	-0.019
72.0	-0.107	28.0	0.088	69.6	-0.044	71.9	-0.016
89.4	-0.086	34.2	-0.139	84.8	-0.038	80.8	-0.010
104.3	-0.078	45.5	-0.162	93.3	-0.036	89.3	-0.007
113.6	-0.075	51.5	-0.157	117.5	-0.026	104.2	-0.002
127.0	-0.072	54.8	-0.156	131.0	-0.020	113.4	0.002
137.7	-0.061	60.5	-0.142	141.5	-0.016	127.0	0.006
148.8	-0.056	69.8	-0.128	152.8	-0.010	137.5	0.007
162.7	-0.048	76.1	-0.119	166.5	-0.003	148.7	0.012
188.4	-0.026	85.0	-0.099	192.3	-0.007	162.5	0.015
200.4	-0.011	93.4	-0.097	204.4	-0.009	188.3	0.020
209.6	-0.005	108.3	-0.057	213.5	0.012	200.4	0.021
223.7	-0.000	117.7	-0.046	227.6	0.014	209.5	0.024
234.6	-0.015	131.0	-0.031	238.6	0.016	223.6	0.024
257.7	0.025	234.4	-0.029	261.6	0.016	234.5	0.025
281.6	0.029	257.4	-0.027	285.5	0.017	257.6	0.023
305.8	0.034	291.4	-0.029	309.8	0.017	281.4	0.026
340.8	0.042	305.8	-0.023	344.8	0.018	305.7	0.026
362.6	0.040	340.6	-0.023	366.5	0.015	340.8	0.023
378.8	0.041	362.3	-0.022	382.6	0.015	362.5	0.020
401.3	0.038	378.5	-0.022	405.2	0.015	378.5	0.019
426.0	0.042	401.0	-0.023	429.8	0.013	401.1	0.018
449.5	0.040	425.8	-0.021	453.3	0.014	425.9	0.018
473.5	0.042	449.3	-0.021	477.3	0.012	449.4	0.014
		473.3	-0.021			472.3	0.014

TABLE XX (continued)

Admixture 0.01 N $CaCl_2$-0.01 N NaOH				Admixture 0.01 N $CaCl_2$-0.01 N NaOH			
Cell No. C 2		Cell No. C 24		Cell No. C 20		Cell No. C 14	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.012	0.0	-0.024	0.0	0.002	0.0	0.018
0.2	0.014	0.4	0.009	0.6	-0.020	0.2	0.009
1.3	0.008	1.7	0.011	1.5	-0.023	1.6	0.144
2.0	-0.010	3.6	0.026	2.0	-0.009	2.2	0.094
2.9	0.104	4.5	0.030	3.0	0.018	2.3	0.070
4.4	0.048	6.4	0.057	5.6	0.051	4.6	0.066
5.6	0.054	7.7	0.142	6.5	0.057	5.3	0.064
7.6	0.074	16.1	0.123	8.5	0.069	7.6	0.052
8.5	0.103	19.9	0.180	9.4	0.075	16.0	-0.016
9.3	0.167	23.5	0.135	10.5	0.106	19.7	-0.068
10.4	0.203	26.3	0.079	11.7	0.101	23.4	-0.110
11.7	0.183	29.8	0.000	22.0	0.043	26.1	-0.123
23.9	0.159	41.0	-0.105	27.6	0.009	41.0	-0.096
27.6	0.076	50.4	-0.140	30.3	-0.007	47.0	-0.087
30.3	0.022	54.6	-0.151	45.1	-0.081	54.5	-0.088
33.9	0.033	56.2	-0.139	58.7	-0.084	56.7	-0.091
45.1	-0.113	65.4	-0.138	69.4	-0.096	65.2	-0.082
54.4	-0.151	71.7	-0.131	75.8	-0.095	71.6	-0.076
58.6	-0.163	80.6	-0.126	84.6	-0.094	80.5	-0.065
69.4	-0.184	89.1	-0.111	93.1	-0.096	89.0	-0.054
75.8	-0.185	104.0	-0.093	108.0	-0.093	103.9	-0.042
93.1	-0.181	113.2	-0.081	117.3	-0.090	113.0	-0.030
108.0	-0.168	126.7	-0.058	130.8	-0.083	126.7	-0.022
130.8	-0.136	137.7	-0.048	141.4	-0.079	137.2	-0.015
141.4	-0.129	148.5	-0.032	152.5	-0.016	148.4	-0.014
152.6	-0.115	162.4	-0.032	166.4	-0.015	162.2	-0.011
166.4	-0.105	188.0	-0.002	192.1	-0.013	188.0	0.002
192.2	-0.088	200.2	-0.000	204.2	-0.012	200.7	-0.001
213.8	-0.085	209.3	-0.001	213.3	-0.012	223.3	-0.001
227.4	-0.077	223.4	-0.006	227.5	-0.010	234.1	0.008
238.3	-0.066	234.3	-0.004	238.3	-0.010	257.2	-0.002
261.4	-0.064	257.4	-0.010	261.4	-0.007	281.1	0.002
285.3	-0.064	281.3	0.013	285.4	-0.006	305.7	0.008
309.5	-0.065	305.5	0.013	304.6	-0.005	340.8	0.010
344.5	-0.062	350.5	-0.007	344.6	-0.004	362.2	0.011
366.3	-0.063	362.2	0.001	366.3	-0.003	378.2	0.010
382.4	-0.064	378.5	0.080	382.5	-0.003	400.8	0.011
405.0	-0.064	401.0	0.000	405.2	-0.003	425.6	0.010
429.7	-0.062	425.6	0.000	429.7	-0.003	449.0	0.009
453.2	-0.058	449.2	0.004	453.3	-0.002	473.0	0.012
477.3	-0.057	473.1	0.000	477.2	-0.002		

TABLE XX (continued)

Admixture 0.1 N $CaCl_2$-0.1 N NaOH				Admixture 0.1 N $CaCl_2$-0.1 NaOH			
Cell No. C 17		Cell No. C 10		Cell No. C 15		Cell No. C 4	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.046	0.0	-0.010	0.0	0.034	0.0	0.004
0.3	-0.112	0.3	-0.170	0.3	0.006	0.4	0.042
1.5	-0.055	1.4	-0.070	1.4	0.057	1.7	0.137
2.3	-0.048	2.0	0.127	2.0	0.053	2.6	0.184
3.5	-0.038	2.5	0.150	2.5	0.062	3.8	0.258
5.4	-0.089	4.4	0.145	3.0	0.000	4.7	0.275
6.4	-0.153	5.6	0.166	4.3	0.154	5.5	0.232
7.7	-0.189	6.4	0.173	5.5	0.211	7.9	0.126
16.1	-0.046	7.6	0.154	7.6	0.251	16.3	0.025
19.8	-0.057	8.6	0.134	8.5	0.254	20.1	0.031
26.3	-0.030	10.5	0.102	10.5	0.244	23.8	0.034
29.9	-0.003	11.7	0.096	11.7	0.219	26.5	0.020
41.2	-0.035	24.0	0.076	20.1	0.118	30.0	0.015
47.2	-0.054	30.3	0.038	27.6	0.021	47.3	0.021
50.4	-0.049	45.2	-0.004	33.9	-0.011	50.6	0.026
54.7	-0.052	54.5	-0.014	45.1	-0.041	54.8	0.029
65.4	-0.054	58.7	-0.012	51.7	-0.038	56.4	0.034
71.8	-0.048	69.5	-0.013	54.4	-0.045	65.6	0.037
80.7	-0.036	75.8	-0.008	58.7	-0.044	71.9	0.038
89.2	-0.040	84.7	-0.000	60.2	-0.045	80.8	0.036
104.1	-0.030	108.1	-0.017	75.8	-0.042	104.2	0.023
113.2	-0.020	127.3	-0.016	93.1	-0.042	113.5	0.025
126.9	-0.011	141.4	0.028	108.2	-0.052	127.0	0.026
137.4	-0.000	152.6	0.022	130.9	-0.049	137.6	0.025
148.5	-0.006	166.4	0.020	141.4	-0.045	148.7	0.022
162.4	-0.014	192.4	0.023	152.6	-0.045	162.5	0.027
188.2	-0.036	204.2	0.020	166.5	-0.046	188.3	0.024
200.2	-0.048	213.4	0.020	192.2	-0.037	200.4	0.022
209.3	-0.052	227.5	0.020	204.2	-0.031	209.5	0.026
223.4	-0.057	238.4	0.020	213.3	-0.034	224.6	0.025
234.2	-0.062	261.5	0.012	229.4	-0.034	234.5	0.025
257.4	-0.062	285.4	0.003	237.8	-0.036	257.6	0.022
281.2	-0.069	309.4	0.000	261.4	-0.036	281.5	0.019
305.6	-0.065	333.6	-0.003	285.2	-0.036	305.5	0.020
340.7	-0.067	390.4	-0.008	308.5	-0.040	340.8	0.019
362.3	-0.060	406.4	-0.001	344.6	-0.040	362.5	0.018
378.4	-0.058	429.7	-0.018	366.3	-0.040	378.6	0.017
401.0	-0.064	453.2	-0.024	382.4	-0.040	401.2	0.016
425.6	-0.050	477.2	-0.024	404.9	-0.038	425.8	0.012
449.2	-0.046			429.6	-0.040	449.4	0.011
473.2	-0.052			453.2	-0.042	473.3	0.008
				479.2	-0.039		

TABLE XXI

CURRENT-TIME VALUES FROM GALVANIC CELLS FOR 5154-H34 ALLOY

Admixture None				Admixture 0.01 N NaOH			
Cell No. D 20		Cell No. D 3		Cell No. D 8		Cell No. D 2	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.000	0.0	0.079	0.0	0.028	0.0	0.052
0.7	0.036	0.7	0.243	0.6	0.319	1.3	0.136
1.0	0.042	1.9	0.266	1.7	0.329	2.6	0.163
2.3	0.041	4.2	0.175	2.3	0.347	4.9	-0.151
4.2	0.052	5.1	0.147	3.3	0.345	5.8	-0.353
6.0	0.125	6.2	0.173	4.0	0.279	7.0	-0.270
8.0	-0.068	10.5	0.257	5.6	0.174	11.3	0.098
9.5	-0.062	13.3	0.184	7.8	0.154	14.1	0.150
11.7	0.004	14.4	0.158	9.3	0.216	15.3	0.137
13.7	0.070	18.1	0.109	12.4	0.220	18.8	0.117
18.2	0.079	22.4	0.058	13.6	0.218	23.2	0.068
21.9	-0.075	35.1	0.016	17.8	0.105	35.5	-0.054
25.6	-0.020	40.6	0.031	21.9	0.119	41.0	-0.017
30.0	-0.016	46.8	0.037	29.8	0.010	57.2	0.003
42.2	0.037	58.4	0.052	42.0	-0.066	58.8	0.042
47.7	0.075	74.1	0.042	53.8	-0.040	74.5	0.057
65.5	0.129	84.6	0.020	65.4	-0.044	85.0	0.074
81.2	0.144	89.3	0.032	80.9	-0.038	89.5	0.057
91.9	0.160	96.4	0.011	90.6	-0.042	96.9	0.051
103.4	0.147	106.1	0.005	96.2	-0.045	106.5	0.047
127.2	0.144	120.1	-0.022	103.5	-0.045	120.5	0.016
140.0	0.137	132.9	-0.025	113.1	-0.046	133.3	0.003
150.3	0.132	143.2	-0.029	126.9	-0.056	143.5	0.005
163.9	0.129	156,9	-0.045	139.1	-0.064	157.2	0.009
173.5	0.124	166.2	-0.043	150.1	-0.074	166.5	-0.002
188.3	0.122	181.3	-0.052	163.6	-0.076	181.5	-0.003
198.0	0.114	190.8	-0.043	173.1	-0.076	191.2	-0.005
208.7	0.112	201.5	-0.051	188.1	-0.076	201.9	-0.005
222.0	0.123	216.7	-0.045	197.6	-0.083	217.1	-0.018
223.8	0.177	225.7	-0.046	208.4	-0.078	226.1	0.024
232.7	0.215	240.6	-0.048	221.4	-0.068	241.0	0.025
247.9	0.197	279.8	-0.048	223.6	-0.064	250.0	0.030
257.0	0.182	264.6	-0.047	247.6	-0.072	265.0	0.030
271.7	0.176	270.9	-0.048	256.6	-0.070	274.3	0.038
281.0	0.170	288.8	-0.047	271.6	-0.069	298.3	0.047
295.7	0.163	297.9	-0.044	295.6	-0.070	346.8	0.064
328.9	0.150	321.8	-0.043	304.9	-0.070	370.4	0.052
377.2	0.136	346.9	-0.038	353.3	0.040	394.4	0.055
425.1	0.124	362.0	-0.031	376.9	-0.034	418.3	0.044
449.1	0.131	394.1	-0.030	400.9	-0.006	422.3	0.063
477.0	0.127	441.9	-0.025	448.9	-0.006	471.8	0.048
		471.5	-0.025	477.0	-0.001		

TABLE XXI (continued)

Admixture 0.05 N NaOH				Admixture 0.10 N NaOH			
Cell No. D 21		Cell No. D 19		Cell No. D 10		Cell No. D 24	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0	0.130	0.0	0.085	0.0	0.043	0.0	0.148
1.3	0.261	1.1	0.154	0.7	0.672	1.2	0.885
2.0	0.245	2.2	0.185	1.7	0.424	2.4	0.030
2.9	-0.051	4.5	-0.202	3.0	-0.678	4.7	-0.220
3.8	-0.205	5.3	-0.136	4.8	-0.552	5.5	-0.171
4.6	-0.377	7.4	-0.047	6.8	-0.249	6.7	0.393
5.8	-0.231	10.8	0.722	8.3	-0.150	11.0	0.168
7.7	-0.382	13.2	0.670	10.5	-0.473	13.8	0.045
11.3	-0.371	14.7	0.774	12.5	-0.712	14.9	-0.174
13.3	-0.474	18.3	0.333	16.9	-0.952	19.5	-0.180
17.7	-0.572	22.7	0.114	21.0	-0.984	22.9	-0.363
20.5	-0.556	35.0	0.047	24.5	-0.993	35.2	-0.258
25.2	-0.506	40.5	-0.036	28.7	-0.923	40.7	-0.229
41.8	-0.229	46.7	-0.041	41.0	-0.853	46.9	-0.194
47.3	-0.141	58.3	-0.012	46.6	-0.797	58.5	-0.170
53.3	-0.053	74.0	0.002	52.8	-0.645	74.2	-0.128
65.1	-0.025	84.5	0.006	64.2	-0.528	84.7	-0.109
80.9	0.027	89.0	0.001	80.0	-0.352	89.2	-0.089
96.5	0.012	97.3	0.006	90.6	-0.244	96.3	-0.068
97.0	0.012	106.0	0.014	95.1	-0.207	106.3	-0.042
104.2	0.023	120.0	0.006	102.5	-0.174	120.2	-0.032
113.8	0.025	132.2	0.060	112.2	-0.148	133.0	-0.041
127.8	0.016	143.0	-0.006	126.0	-0.109	143.6	-0.035
140.8	0.010	156.6	-0.024	139.2	-0.093	156.9	-0.028
164.5	0.003	166.0	-0.008	149.2	-0.077	166.3	-0.012
178.1	0.014	181.0	-0.013	162.8	-0.074	181.3	0.012
189.0	0.029	190.7	-0.019	172.2	-0.050	190.9	0.011
198.6	0.023	201.4	0.010	187.2	-0.042	201.6	0.013
209.3	0.026	216.6	0.040	196.7	-0.029	214.8	0.046
222.7	0.057	225.6	0.022	207.5	-0.030	216.8	0.051
224.3	0.061	240.5	0.050	222.7	-0.006	225.8	0.062
272.3	0.050	249.7	0.037	231.7	-0.005	240.7	0.065
296.5	0.035	264.5	0.031	246.7	-0.012	264.7	0.055
305.6	0.035	273.8	0.032	270.7	-0.000	288.8	0.029
354.2	0.033	288.6	0.028	279.9	-0.008	321.9	0.032
377.8	0.028	297.2	0.032	294.8	-0.004	346.5	0.038
401.8	0.033	321.7	0.033	303.9	-0.006	370.2	0.032
425.7	0.029	346.3	0.019	327.7	-0.005	394.1	0.026
449.7	0.141	369.8	0.098	352.3	-0.007	418.0	0.018
478.8	0.128	417.0	0.080	400.0	-0.011	442.0	0.018
		471.3	0.088	448.0	-0.004	471.5	0.013
				477.5	-0.004		

TABLE XXI(continued)

Admixture 0.01 N $CaCl_2$				Admixture 0.10 N $CaCl_2$			
Cell No. D 16		Cell No. D 1		Cell No. D 12		Cell No. D 5	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.067	0.0	0.026	0.0	0.013	0.0	0.027
0.6	0.088	1.5	0.100	0.5	0.104	1.5	0.052
1.5	0.083	2.9	0.076	2.2	0.098	3.6	0.022
2.3	0.090	3.1	-0.023	3.0	0.101	4.6	0.075
3.2	0.057	6.0	-0.071	4.1	0.079	5.8	0.167
6.0	0.057	7.2	-0.067	6.1	0.094	10.1	0.072
7.5	0.100	11.5	-0.129	7.7	0.243	12.6	0.019
10.7	0.327	14.0	0.000	10.0	0.217	14.1	-0.004
11.8	0.333	15.4	0.094	12.0	0.177	17.5	-0.013
16.2	0.326	18.9	0.210	16.3	0.072	22.0	0.032
20.3	0.252	33.3	0.224	19.2	0.037	34.2	0.032
28.0	0.102	35.5	0.116	23.9	0.045	39.8	0.007
40.2	0.396	46.2	0.062	28.3	0.048	46.0	-0.020
46.0	0.040	47.4	0.022	40.5	-0.066	57.4	-0.009
52.0	0.011	59.0	0.019	46.0	-0.055	73.3	0.018
63.5	0.026	74.7	0.015	63.9	-0.009	83.8	0.026
79.7	0.033	85.1	0.028	79.5	0.025	88.3	0.018
89.9	0.026	89.7	0.022	90.0	0.034	95.7	0.011
94.5	0.022	97.1	0.022	94.6	0.025	105.3	0.006
101.2	0.004	106.7	0.020	102.0	0.010	119.2	-0.038
111.3	0.001	120.5	0.008	111.5	0.005	131.5	-0.063
125.3	-0.010	132.8	0.000	123.5	-0.024	142.5	-0.086
137.5	-0.002	143.7	-0.010	138.3	-0.025	156.0	-0.106
162.0	-0.014	157.3	-0.016	148.6	-0.060	165.5	-0.119
170.5	-0.017	166.7	-0.018	162.2	-0.084	180.5	-0.118
186.5	-0.026	191.2	-0.017	186.7	-0.093	200.8	-0.119
206.8	-0.024	202.0	-0.022	196.2	-0.093	213.7	-0.120
219.3	-0.021	215.0	-0.020	206.9	-0.097	216.1	-0.119
219.4	-0.026	217.2	-0.017	222.1	-0.090	225.0	-0.133
222.0	-0.025	226.2	-0.025	231.1	-0.096	240.0	-0.126
231.0	-0.032	241.2	-0.032	246.0	-0.095	249.0	-0.126
255.0	-0.036	250.3	-0.034	255.0	-0.095	264.0	-0.120
270.0	-0.038	265.2	-0.036	270.0	-0.094	273.2	-0.120
294.0	-0.035	273.5	-0.038	297.3	-0.096	288.1	-0.114
303.0	-0.036	298.5	-0.038	303.5	-0.095	297.2	-0.115
327.0	-0.031	322.3	-0.041	351.8	-0.086	321.0	-0.104
375.3	-0.026	370.5	-0.042	375.5	-0.084	345.7	-0.100
399.0	-0.023	394.5	-0.041	399.5	-0.086	393.3	-0.086
423.0	-0.018	418.5	-0.038	423.4	-0.080	417.3	-0.080
447.0	-0.020	442.5	-0.036	447.3	-0.081	441.3	-0.080
476.8	-0.018	472.0	-0.038	476.8	-0.078	470.8	-0.074

TABLE XXI (continued)

Admixture 1.0 N $CaCl_2$				Admixture 0.01 N $CaCl_2$-0.01 N NaOH			
Cell No. D 18		Cell No. D 17		Cell No. D 9		Cell No. D 22	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.125	0.0	0.025	0.0	0.051	0.0	0.137
0.2	0.442	1.5	0.032	0.3	0.048	0.8	0.175
1.3	0.239	3.5	0.213	1.8	0.045	1.8	0.167
2.0	0.376	4.3	0.191	3.0	0.039	2.6	0.185
3.9	0.289	5.5	0.164	5.0	-0.180	3.8	-0.015
7.3	0.130	9.8	0.053	9.7	-0.307	8.2	-0.222
9.5	0.016	12.7	-0.006	10.5	-0.334	11.0	0.047
10.3	-0.019	13.7	0.001	11.5	-0.245	12.0	0.119
16.0	-0.115	17.5	-0.019	16.0	-0.002	15.6	0.213
18.8	-0.134	21.8	-0.053	18.5	0.051	20.0	0.245
23.4	-0.176	34.0	-0.081	23.4	0.079	32.3	0.032
27.8	-0.198	39.5	0.012	27.8	0.023	37.8	0.033
45.5	-0.058	45.8	0.052	40.1	0.013	44.0	-0.058
51.8	-0.010	57.0	0.073	45.7	0.041	55.4	-0.054
63.4	0.003	73.0	0.081	51.9	0.054	71.5	-0.041
89.7	0.009	83.6	0.089	63.3	0.065	81.8	-0.043
94.2	0.011	88.1	0.087	79.3	0.053	86.4	-0.046
101.3	0.013	95.4	0.086	89.7	0.056	93.6	-0.042
111.1	0.011	105.0	0.087	94.3	0.004	103.3	-0.035
125.0	0.011	119.0	0.047	101.7	0.043	117.3	-0.035
138.0	0.011	131.8	0.034	111.3	0.038	130.1	-0.034
148.0	-0.006	142.0	0.013	125.1	0.024	140.3	-0.036
161.7	-0.005	155.7	0.020	137.3	0.012	154.0	-0.044
171.3	-0.003	165.0	0.018	148.3	0.002	163.3	-0.036
186.2	-0.006	180.2	0.017	161.8	0.008	178.3	-0.034
195.8	-0.009	200.5	0.010	186.3	0.006	198.8	-0.036
221.6	0.011	213.7	0.042	195.8	0.003	213.9	-0.006
230.7	0.009	215.6	0.033	206.5	0.010	222.9	-0.006
245.7	0.006	224.6	0.032	219.3	0.014	237.8	-0.000
254.8	0.006	239.6	0.031	219.3	0.012	247.1	-0.000
269.6	0.007	248.8	0.031	230.8	0.026	261.8	-0.000
278.9	0.007	263.5	0.037	245.8	0.023	271.1	0.001
293.7	0.009	272.8	0.035	269.8	0.030	280.0	0.004
303.0	0.006	296.9	0.034	293.8	0.037	295.2	0.004
326.8	0.006	320.7	0.033	326.8	0.044	319.1	0.006
351.3	0.006	346.3	0.030	351.3	0.056	343.6	0.012
375.0	0.005	369.0	0.029	375.0	0.049	367.2	0.010
399.0	0.007	393.0	0.025	399.0	0.041	391.2	0.013
423.0	0.005	416.8	0.023	423.0	0.104	415.2	0.011
446.9	0.005	440.9	0.022	447.0	0.029	439.2	0.019
476.4	0.006	470.4	0.021	476.5	0.088	468.7	0.018

TABLE XXI (continued)

Admixture 0.10 N $CaCl_2$-0.01 N NaOH				Admixture 0.1 N $CaCl_2$-0.1 N NaOH			
Cell No. D 15		Cell No. D 7		Cell No. D 23		Cell No. D 6	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.044	0.0	0.334	0.0	0.022	0.0	0.060
1.0	0.031	0.8	0.162	0.8	0.072	0.6	0.203
2.8	0.052	1.8	0.233	1.7	0.039	1.4	0.261
4.9	0.088	2.6	0.305	2.7	0.046	2.3	0.382
6.3	0.085	3.8	0.372	6.0	0.026	3.5	0.254
8.6	0.382	8.1	0.212	9.2	0.428	7.8	0.015
10.6	0.333	11.0	0.296	10.4	0.500	10.3	0.351
15.0	0.217	11.9	0.259	14.7	0.484	11.9	0.371
17.5	0.210	15.7	0.163	18.8	0.335	15.1	0.194
18.9	0.196	20.0	0.129	22.0	0.180	19.6	-0.056
22.4	0.192	32.5	0.036	26.5	0.070	31.8	-0.151
26.8	0.140	37.8	0.044	38.8	0.011	37.4	-0.210
39.1	0.080	44.0	0.049	44.4	-0.022	43.6	-0.194
44.7	0.010	54.6	0.054	50.5	-0.032	55.0	-0.203
50.8	0.022	71.3	0.027	62.0	0.041	70.8	-0.105
62.5	0.040	81.9	0.008	77.8	-0.038	81.4	-0.092
78.2	0.050	86.5	0.006	88.4	-0.022	86.0	-0.086
88.7	0.052	93.0	-0.025	93.0	-0.026	93.4	-0.070
93.2	0.035	103.4	-0.032	100.3	-0.022	102.8	-0.056
100.6	0.019	117.3	-0.046	109.8	-0.018	116.8	-0.049
110.2	0.002	130.1	-0.052	124.0	-0.007	129.0	-0.031
124.2	0.030	140.3	-0.058	136.0	-0.005	140.0	-0.023
136.3	-0.062	154.0	-0.060	147.0	0.002	153.5	-0.084
147.2	-0.078	163.3	-0.057	160.5	0.015	163.0	-0.008
160.7	-0.098	178.5	-0.053	170.0	0.019	178.0	-0.010
170.2	-0.102	188.1	-0.050	185.0	0.029	187.5	0.020
185.2	-0.110	198.8	0.048	194.5	0.035	198.3	0.025
194.7	-0.110	210.2	0.030	205.2	0.042	210.8	0.034
205.6	-0.110	213.9	-0.034	217.6	0.052	210.8	0.028
218.7	-0.108	223.0	-0.048	220.5	-0.061	213.5	0.030
220.8	-0.108	238.0	-0.048	244.5	-0.114	222.5	0.040
229.7	-0.108	247.3	-0.048	253.5	-0.113	237.4	0.044
244.7	-0.108	262.0	-0.044	268.5	-0.105	246.5	0.046
253.9	-0.106	271.3	-0.043	277.7	-0.100	261.5	0.049
268.7	-0.104	286.2	-0.038	292.5	-0.091	270.7	0.028
278.0	-0.104	295.4	-0.037	301.5	-0.085	285.6	0.020
292.8	-0.100	319.3	-0.032	325.5	-0.074	294.5	0.020
301.2	-0.100	343.8	-0.025	350.2	-0.065	318.5	0.022
350.4	-0.090	367.5	-0.019	373.8	-0.054	343.3	0.022
373.0	-0.083	415.4	-0.016	421.8	-0.043	390.6	0.042
422.0	-0.072	439.4	-0.014	445.8	-0.038	438.6	0.040
475.6	-0.066	468.9	-0.011	475.3	-0.034	468.4	0.044

TABLE XXI (continued)

Admixture 1.0 N $CaCl_2$-0.05 N NaOH				Admixture 1.0 N $CaCl_2$-0.10 N NaOH			
Cell No. D 4		Cell No. D 14		Cell No. D 13		Cell No. D 11	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.224	0.0	0.791	0.0	0.151	0.0	0.092
0.7	0.608	0.5	0.311	0.5	0.454	0.3	0.554
1.6	0.795	1.3	0.366	1.3	0.360	1.2	-0.522
2.6	0.664	2.2	0.213	2.3	0.458	2.1	-0.322
4.6	0.376	3.4	0.449	4.3	0.373	3.3	-0.069
6.1	0.212	7.8	0.091	8.0	0.142	7.6	0.028
8.3	0.059	10.3	0.000	10.0	0.096	10.1	0.059
9.2	0.014	11.7	-0.032	14.4	0.021	11.6	0.072
10.3	0.042	15.2	-0.083	17.3	-0.011	15.0	0.002
14.6	-0.113	19.3	-0.110	22.0	-0.044	19.4	0.004
17.5	-0.123	31.9	-0.091	26.3	-0.047	31.6	0.005
18.5	-0.112	37.5	-0.015	38.5	0.026	37.3	0.012
22.1	-0.104	43.7	0.016	44.3	0.053	43.5	0.047
26.5	-0.084	55.3	0.032	50.3	0.060	55.0	0.004
38.8	-0.017	71.0	0.026	61.8	0.057	70.8	0.000
44.3	-0.001	81.5	0.019	88.1	0.036	81.2	0.002
50.5	0.010	86.0	0.019	92.7	0.031	85.8	0.003
62.1	0.013	93.4	0.020	109.5	0.024	93.3	-0.001
77.8	0.007	103.0	0.023	123.5	0.016	103.0	0.000
88.3	0.003	117.0	0.206	136.4	0.016	116.7	-0.001
92.9	0.001	127.6	0.259	146.6	0.014	128.9	0.001
100.2	0.000	140.0	0.210	160.2	0.015	139.8	0.000
109.8	0.003	153.6	0.251	169.8	0.013	153.3	0.000
123.8	0.010	163.0	0.383	184.7	0.013	162.8	0.000
136.6	-0.004	178.0	0.416	194.3	0.012	177.8	0.002
146.9	-0.003	187.5	0.406	205.0	0.012	187.3	-0.003
160.5	-0.004	198.3	0.350	220.1	0.016	198.1	0.000
169.9	-0.000	211.4	0.006	229.1	0.015	469.3	0.000
185.0	-0.054	213.6	0.016	244.2	0.015		
194.5	-0.000	222.5	0.015	253.3	0.016		
205.2	-0.000	237.5	0.017	268.0	0.061		
220.4	-0.000	261.5	0.020	277.3	0.014		
373.7	0.000	270.8	0.019	292.2	0.013		
445.7	0.000	285.6	0.018	301.4	0.013		
475.1	0.000	294.7	0.018	325.2	0.013		
		318.7	0.017	349.9	0.013		
		343.3	0.019	373.5	0.011		
		366.8	0.016	397.5	0.011		
		390.8	0.015	421.4	0.008		
		414.8	0.013	469.4	0.009		
		438.8	0.016	474.9	0.007		
		467.3	0.015				

TABLE XXII

CURRENT-TIME VALUES FROM GALVANIC CELLS FOR 5154-H34 ALLOY

Admixture None				Admixture None			
Cell No. E 14		Cell No. E 18		Cell No. E 2		Cell No. E 1	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.044	0.0	0.015	0.0	0.054	0.0	0.173
0.3	0.039	0.5	0.067	0.9	0.107	0.3	0.106
0.6	0.024	1.3	-0.104	1.6	0.016	0.6	0.058
1.2	-0.197	1.6	-0.128	2.0	-0.031	1.2	0.017
1.9	-0.240	2.3	-0.086	2.8	-0.056	1.8	-0.074
2.7	-0.293	2.8	-0.084	3.2	-0.060	2.7	-0.044
3.1	-0.273	3.3	-0.081	3.7	-0.130	3.1	-0.010
3.6	-0.270	4.1	0.044	4.3	-0.131	3.6	0.021
4.2	-0.175	5.8	0.129	6.4	-0.047	4.2	0.045
5.4	-0.058	7.7	0.286	8.0	-0.048	4.7	0.058
7.3	-0.055	9.6	0.066	9.8	-0.003	5.4	0.139
9.0	-0.052	11.6	0.058	11.8	-0.003	7.1	0.192
11.0	-0.021	19.7	0.078	20.0	0.045	9.1	0.114
13.0	0.014	23.2	0.060	23.4	0.036	11.0	0.060
21.3	0.030	26.3	0.033	26.6	0.038	13.0	0.066
24.7	0.022	30.0	0.006	30.3	0.025	21.3	0.023
27.8	0.016	34.3	-0.010	34.4	0.022	24.6	0.015
31.6	0.011	44.8	-0.037	45.0	0.018	27.8	0.002
35.8	0.005	59.2	-0.030	59.3	0.000	31.5	0.006
46.3	-0.004	68.5	-0.044	68.6	-0.021	35.7	-0.006
60.6	-0.026	82.3	-0.036	82.4	0.007	46.3	-0.030
70.0	-0.056	92.3	-0.020	92.4	0.005	60.6	-0.036
83.8	-0.069	106.7	-0.018	107.9	0.006	70.0	-0.050
93.7	-0.086	116.2	-0.016	116.4	0.006	83.7	-0.062
108.3	-0.043	131.0	-0.020	131.2	0.116	93.7	-0.068
117.7	-0.032	140.4	-0.022	140.7	0.015	108.3	-0.070
132.5	-0.009	164.4	-0.000	164.6	0.017	117.7	-0.066
142.0	-0.008	198.3	0.014	198.6	0.027	132.5	-0.052
166.0	-0.028	212.3	0.016	212.7	0.029	142.0	-0.048
199.8	0.047	236.5	0.022	236.7	0.032	165.9	-0.032
213.8	0.050	260.5	0.022	260.8	0.029	199.8	-0.010
238.0	0.056	284.5	0.021	284.9	0.036	213.8	-0.005
262.0	0.057	308.2	0.013	308.4	0.036	237.9	-0.001
286.0	0.054	344.0	-0.003	344.2	0.039	262.0	0.004
309.8	0.050	404.8	-0.000	404.9	0.042	286.0	0.008
345.5	0.046	428.5	-0.022	428.5	0.041	309.7	0.010
406.3	0.044	452.8	-0.006	452.0	0.041	345.5	0.010
429.9	0.032	487.8	-0.008	487.0	0.042	406.3	0.014
455.3	0.026					430.0	0.010
489.3	0.033					454.3	0.012
						489.3	0.006

TABLE XXII (continued)

Admixture 0.01 N NaOH

Cell No. E 3 Time Hours	Cell No. E 3 Current M. A.	Cell No. E 15 Time Hours	Cell No. E 15 Current M. A.
0.0	0.058	0.0	-0.004
0.4	0.374	0.7	-0.040
1.3	0.061	1.2	-0.088
1.8	0.148	1.7	-0.098
2.4	0.377	2.3	-0.084
2.9	0.542	2.8	-0.080
3.4	0.717	3.5	-0.082
4.0	0.742	5.4	-0.000
4.7	0.816	7.1	0.807
6.3	0.813	9.1	0.836
8.3	0.588	11.0	0.662
10.3	0.466	19.1	0.317
12.3	0.495	22.7	0.178
20.5	0.364	25.9	0.108
23.9	0.246	29.6	0.071
27.0	0.200	33.8	0.056
30.8	0.138	44.2	0.022
35.0	0.119	58.7	0.004
45.5	0.048	68.0	-0.020
59.8	0.019	72.8	-0.044
69.2	-0.016	91.8	-0.052
83.0	-0.030	106.3	-0.054
92.9	-0.044	115.8	-0.055
107.4	-0.037	130.6	-0.040
116.9	-0.042	140.0	-0.042
131.7	-0.019	164.8	-0.033
141.1	-0.033	197.9	-0.020
165.1	-0.030	211.9	-0.018
199.0	-0.022	236.0	-0.014
213.0	-0.022	260.0	-0.015
237.5	-0.018	284.2	-0.012
261.2	-0.020	308.2	-0.018
285.2	-0.013	353.5	-0.016
308.9	-0.020	404.2	-0.013
344.7	-0.034	428.0	-0.015
405.5	-0.032	452.3	-0.018
429.2	-0.044	487.8	-0.019
453.3	-0.053		
488.4	-0.046		

Admixture 0.01 N NaOH

Cell No. E 4 Time Hours	Cell No. E 4 Current M. A.	Cell No. E 7 Time Hours	Cell No. E 7 Current M. A.
0.0	0.030	0.0	-0.002
0.4	0.048	0.7	0.038
1.0	-0.033	1.1	0.030
1.8	-0.076	1.4	0.094
2.3	-0.106	1.6	0.080
2.8	-0.120	2.3	0.037
3.3	-0.121	2.7	0.016
3.8	-0.084	3.4	0.034
4.7	-0.024	5.1	0.518
6.3	0.266	7.0	0.800
8.3	0.268	9.0	0.676
10.3	0.250	11.0	0.478
12.3	0.234	18.8	0.285
20.5	0.086	22.6	0.180
23.8	0.067	25.8	0.108
27.0	0.052	29.5	0.072
30.8	0.037	33.8	0.045
34.9	0.030	44.3	0.002
45.5	0.017	58.7	-0.003
59.8	0.031	68.0	-0.024
69.5	0.020	81.8	-0.036
83.0	-0.001	91.7	-0.034
93.0	-0.008	106.3	-0.032
107.5	-0.008	115.7	-0.031
117.0	-0.008	130.5	-0.200
132.0	-0.004	140.0	-0.120
141.1	-0.001	164.0	-0.014
165.1	-0.006	197.8	-0.008
189.0	0.016	211.8	-0.005
213.0	0.020	236.0	-0.000
237.1	0.024	260.0	0.002
261.1	0.030	284.0	0.001
285.3	0.038	307.7	0.005
309.0	0.030	343.5	-0.029
345.0	0.018	403.3	-0.030
405.5	0.021	428.1	-0.032
429.1	0.019	452.3	-0.038
453.5	0.022	487.3	-0.044
488.5	0.021		

TABLE XXII (continued)

Admixture 0.05 N $NaOH$				Admixture 0.05 N $NaOH$			
Cell No. E 22		Cell No. E 24		Cell No. E 12		Cell No. E 13	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	-0.650	0.0	0.081	0.0	0.032	0.0	-0.005
0.2	-0.020	0.4	-0.285	0.3	-0.012	0.3	0.065
0.5	0.215	1.2	0.163	1.2	0.194	0.4	0.081
1.1	-0.077	1.6	0.153	1.6	-0.030	1.2	0.111
2.0	-0.266	2.1	0.347	2.1	0.124	2.1	0.148
2.8	-0.198	2.7	0.387	2.3	0.284	2.8	-0.081
3.1	0.041	3.2	0.397	3.2	0.406	3.1	-0.011
3.7	0.231	4.0	0.542	4.0	0.739	3.8	0.090
4.3	0.338	5.8	0.434	5.6	0.971	4.2	0.175
4.8	0.322	7.5	0.061	7.6	0.642	4.8	0.246
5.4	0.554	9.5	0.113	9.5	1.100	5.6	0.289
7.5	0.055	11.5	0.210	11.5	1.329	7.5	0.205
9.0	0.084	19.8	0.188	19.7	0.836	9.1	0.182
11.0	0.182	23.2	0.159	23.1	0.638	11.0	0.167
12.9	0.210	26.3	0.112	26.3	0.578	13.0	0.126
21.1	0.112	30.1	0.070	30.0	0.462	21.1	0.046
24.5	0.103	34.3	0.048	34.2	0.346	24.6	0.039
27.7	0.010	44.8	0.036	44.7	0.154	27.8	0.036
31.4	0.090	59.1	0.029	59.1	0.116	31.4	0.041
35.6	0.094	68.5	0.026	68.5	0.068	35.6	0.046
46.2	0.077	82.3	0.026	82.2	0.026	46.2	0.044
60.5	0.053	92.2	0.016	92.2	0.010	60.6	0.037
69.8	0.030	106.8	0.036	106.8	0.006	69.8	0.048
83.5	0.038	116.3	0.027	116.2	0.003	83.6	0.026
93.6	0.037	121.0	0.039	119.0	0.012	93.6	0.021
108.0	0.034	140.5	0.027	140.3	-0.002	108.1	0.016
117.6	0.026	164.5	0.020	164.4	-0.015	117.6	0.019
132.3	0.021	198.3	0.000	198.3	-0.023	132.3	0.014
141.8	0.018	212.3	-0.008	212.3	-0.033	141.9	0.011
165.8	0.004	236.5	-0.021	236.4	-0.039	165.8	0.064
199.7	0.008	260.5	-0.027	260.0	-0.052	199.0	-0.050
213.7	0.014	284.6	-0.037	284.5	-0.050	213.7	-0.080
237.8	-0.021	308.3	-0.048	308.3	-0.054	237.8	-0.089
262.9	-0.034	344.0	-0.066	344.0	-0.058	262.0	-0.077
287.9	-0.038	404.8	-0.060	404.8	-0.041	286.0	-0.016
309.6	-0.048	428.5	-0.078	428.5	-0.055	310.0	-0.013
345.3	-0.048	452.5	-0.090	452.8	-0.052	345.3	-0.018
406.2	-0.035	487.8	-0.101	487.8	-0.058	406.2	0.021
429.8	-0.047					429.7	0.020
454.2	-0.047					454.2	0.019
488.1	-0.054					489.2	0.016

TABLE XXII (continued)

Admixture 0.1 N $CaCl_2$				Admixture 0.1 N $CaCl_2$			
Cell No. E 19		Cell No. E 23		Cell No. E 9		Cell No. E 11	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.009	0.0	0.034	0.0	-0.002	0.0	0.056
0.1	0.023	0.1	0.005	0.1	-0.008	0.0	0.062
0.4	0.031	0.3	0.000	0.3	0.014	0.4	-0.216
0.9	0.048	1.0	0.094	1.0	0.058	1.1	-0.144
1.7	0.209	1.5	0.166	1.7	0.069	1.5	-0.131
2.4	0.035	2.0	0.272	2.4	0.098	2.1	-0.126
2.9	0.415	2.6	0.373	2.9	0.114	2.6	-0.404
3.5	0.496	3.1	0.402	3.4	0.126	3.2	-0.363
4.0	0.521	3.8	0.398	4.0	0.170	3.9	0.106
4.5	0.552	5.8	0.346	4.3	0.180	6.9	0.104
5.2	0.560	7.5	0.203	5.2	0.170	7.5	0.071
7.2	0.622	9.5	0.112	7.0	0.095	9.4	0.126
8.9	0.443	11.4	0.146	8.8	0.077	11.6	0.307
10.8	0.280	19.5	0.053	10.8	0.140	19.0	0.026
12.8	0.202	23.0	0.018	12.8	0.085	23.0	0.012
20.8	0.067	26.2	-0.013	22.0	0.045	26.2	0.003
24.4	0.050	29.8	-0.048	24.4	0.026	29.8	-0.020
27.5	0.028	34.0	-0.071	27.5	0.020	34.0	0.045
29.3	0.016	44.4	-0.098	31.2	0.011	44.7	-0.052
35.4	0.005	59.0	-0.105	35.4	0.001	59.0	-0.038
46.0	-0.036	68.3	-0.096	46.0	-0.013	68.4	-0.101
60.4	-0.046	82.0	-0.070	60.2	-0.007	82.0	-0.099
69.5	-0.032	92.0	-0.060	69.5	-0.004	92.1	-0.103
83.3	-0.020	106.5	-0.024	83.3	0.010	102.5	-0.139
93.4	-0.031	116.0	-0.036	93.3	0.010	116.0	-0.062
107.8	-0.017	130.8	-0.009	107.8	0.019	130.8	-0.026
117.3	-0.006	140.3	-0.000	117.3	0.025	140.3	0.026
132.1	0.007	164.3	-0.019	132.0	0.029	164.3	0.035
141.6	0.016	198.1	-0.042	141.5	0.036	198.2	0.029
165.5	0.039	212.1	-0.054	165.5	0.037	212.3	0.033
199.5	0.068	236.3	0.067	199.3	0.042	236.3	0.034
213.5	0.069	260.3	0.059	213.3	0.044	260.3	0.036
237.5	0.073	284.4	0.061	237.3	0.042	284.4	-0.080
261.6	0.077	308.0	0.061	261.5	0.042	308.0	-0.069
285.7	0.076	343.8	0.045	285.6	0.046	343.8	0.022
309.3	0.077	404.4	0.050	309.3	0.042	404.5	0.016
345.0	0.072	428.3	0.046	345.0	0.034	428.3	0.016
405.9	0.068	452.4	0.047	405.5	0.035	452.7	0.012
429.5	0.063	487.5	0.040	429.5	0.034	487.6	0.014
454.0	0.063			454.0	0.033		
489.0	0.058			488.8	0.028		

TABLE XXII (continued)

Admixture 0.1 N $CaCl_2$-0.1 N NaOH				Admixture 0.1 N $CaCl_2$-0.1 N NaOH			
Cell No. E 16		Cell No. E 17		Cell No. E 8		Cell No. E 5	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	1.556	0.0	0.014	0.0	0.020	0.0	-0.007
0.4	1.668	0.3	0.040	0.2	-0.132	0.2	0.039
0.6	1.700	1.9	0.046	1.0	0.109	0.8	0.358
1.0	1.734	1.4	0.137	1.5	0.124	1.7	0.534
1.6	1.710	2.0	0.276	2.1	0.222	2.4	0.558
2.1	1.600	3.5	0.500	2.7	0.287	3.0	0.654
2.9	1.468	3.0	0.897	3.1	0.546	3.4	0.644
4.7	1.232	3.7	0.882	3.8	0.662	4.0	0.559
6.5	1.166	7.8	2.913	5.8	0.644	4.5	0.453
8.5	1.143	7.3	2.038	7.4	0.300	5.1	0.399
10.4	0.920	9.3	1.705	9.3	0.105	7.2	0.256
18.8	0.426	7.3	1.694	11.3	0.126	8.7	0.208
22.1	0.316	19.4	0.754	19.5	0.107	10.6	0.162
25.3	0.261	22.9	0.619	22.9	0.083	12.6	0.132
29.0	0.200	26.0	0.534	26.1	0.083	17.8	0.065
33.2	0.142	29.7	0.400	29.9	0.068	24.2	0.055
43.8	0.054	33.9	0.316	34.0	0.061	27.3	0.040
58.1	0.029	44.5	0.143	44.6	0.046	31.1	0.032
67.5	0.018	58.8	0.060	58.9	0.046	35.2	0.003
81.3	0.020	68.1	0.030	68.3	0.048	45.8	0.033
91.3	0.018	81.9	0.014	83.0	0.048	00.2	0.038
105.7	0.022	91.9	0.008	92.0	0.043	69.5	0.004
115.2	0.016	106.4	0.016	106.5	0.051	83.2	0.046
130.0	0.021	115.9	0.002	116.3	0.044	93.3	0.039
138.5	0.021	130.7	0.014	130.8	0.055	97.7	0.050
163.3	0.015	140.2	0.000	140.2	0.057	117.3	0.051
197.4	0.011	164.1	0.007	164.2	0.039	132.0	0.054
211.3	0.006	198.0	-0.012	198.1	0.052	141.5	0.065
235.5	0.004	212.0	-0.017	212.4	0.048	165.4	0.058
259.5	0.000	236.1	-0.024	236.2	0.048	199.4	0.052
283.5	-0.004	260.2	-0.032	260.3	0.041	213.4	0.054
307.5	-0.008	284.3	-0.037	284.4	0.045	237.5	0.049
343.0	-0.013	307.9	-0.046	308.0	0.044	261.6	0.041
403.8	-0.006	343.6	-0.047	343.7	0.048	285.6	0.049
427.5	-0.012	404.5	-0.042	404.0	0.046	309.3	0.045
451.8	-0.019	428.1	-0.048	428.2	0.037	345.0	0.047
486.8	-0.022	452.5	-0.045	452.6	0.038	405.9	0.041
		487.5	-0.048	487.5	0.000	428.5	0.043
						453.8	0.044
						488.8	0.035

TABLE XXII (continued)

Admixture 0.01 N $CaCl_2$-0.01 N NaOH				Admixture 0.01 N $CaCl_2$-0.01 N NaOH			
Cell No. E 21		Cell No. E 20		Cell No. E 6		Cell No. E 10	
Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.	Time Hours	Current M. A.
0.0	0.034	0.0	0.070	0.0	0.014	0.0	-0.005
0.8	0.002	0.6	0.154	0.6	0.012	0.1	-0.007
1.2	-0.061	1.3	0.030	1.3	0.000	1.0	0.009
1.8	-0.082	2.1	0.015	2.3	0.011	1.4	-0.028
2.3	-0.086	2.3	0.010	2.6	0.013	2.0	-0.032
2.8	-0.110	3.1	0.039	3.2	-0.016	2.6	-0.034
3.5	-0.093	3.7	0.155	3.7	-0.013	3.1	0.042
5.4	-0.594	4.2	0.244	4.2	-0.011	3.7	0.093
7.2	-0.794	4.9	0.251	4.9	-0.014	5.8	0.557
9.1	0.485	6.9	0.368	6.9	0.648	7.0	0.475
11.1	0.565	8.5	0.332	8.6	0.828	9.3	0.212
91.7	-0.108	10.4	0.238	10.5	1.098	11.2	0.097
106.3	-0.044	12.4	0.205	12.5	1.193	19.4	0.101
115.8	-0.035	20.6	0.087	20.4	0.401	22.7	0.074
130.5	-0.020	24.0	0.058	24.0	0.241	26.0	0.058
140.0	-0.022	27.0	0.048	27.2	0.119	29.7	0.047
164.0	-0.008	30.9	0.031	30.9	0.044	33.8	0.036
198.0	-0.000	36.1	0.026	36.1	0.000	44.4	0.016
212.0	0.004	45.7	0.010	45.7	-0.551	58.7	-0.005
236.0	0.008	60.0	0.046	60.0	-0.078	68.0	-0.048
260.0	0.010	69.3	0.019	69.3	-0.105	81.8	-0.031
284.2	0.003	83.1	0.025	83.1	-0.117	91.8	-0.035
307.7	0.001	93.1	-0.024	93.1	-0.117	106.3	-0.035
343.5	0.011	107.6	-0.022	107.6	-0.109	115.8	-0.033
404.3	-0.002	117.1	-0.019	117.1	-0.101	130.6	-0.028
428.0	-0.000	131.9	-0.010	131.9	-0.091	140.0	-0.025
453.8	-0.002	141.3	-0.004	141.3	-0.079	166.2	-0.020
487.3	-0.003	165.3	0.007	165.3	-0.064	198.3	-0.007
		199.2	0.013	199.2	-0.045	212.0	-0.008
		213.2	0.018	113.2	-0.041	236.1	-0.008
		237.3	0.020	237.3	-0.034	260.2	-0.072
		261.4	0.024	261.4	-0.032	248.2	-0.011
		285.5	0.025	285.5	-0.032	307.8	-0.012
		309.1	0.023	309.1	-0.031	343.5	-0.012
		344.8	0.020	344.8	-0.039	404.4	-0.014
		405.7	0.022	405.7	-0.034	428.0	-0.013
		429.3	0.023	429.3	-0.039	452.0	-0.012
		453.7	0.031	443.7	-0.042	487.4	-0.009
		488.6	0.026	488.6	-0.038		

TABLE XXIII

RESISTANCE DATA AND CALCULATED VOLUME LOSS FOR 6061-T6 ALLOY

Cell No. B 17

Admixture 0.05 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
81	0.1904		0
81	0.2104	0.08	15.7
81	0.2150	0.10	25.7
81	0.2405	0.20	38.9
81	0.2433	0.21	49.2
81	0.3086	0.46	63.4
81	0.3062	0.45	73.7
81	0.3144	0.48	90.4
81	0.3493	0.62	133.2
81	0.3686	0.68	158.2
81	0.3700	0.69	192.7
81	0.4115	0.85	209.7
81	0.4038	0.82	241.2
81	0.4559	1.01	276.0
83	0.8638	1.76	301.2
83	0.6425	0.97	324.7
83	0.7110	1.22	349.2
83	0.6790	1.10	377.2
83	0.6866	1.13	395.9
83	0.7380	1.32	421.8
83.	0.7522	1.37	443.4
83	0.7590	1.39	469.2
83	0.7740	1.44	492.2

Cell No. B 20

Admixture 0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
71	0.0726		0
71	0.0514	-0.14	1.0
71	0.0561	-0.11	4.2
71	0.1348	0.40	17.0
71	0.3463	1.66	32.7
71	0.4932	2.47	42.6
71	0.6760	3.39	55.9
71	0.8384	4.15	66.2
62	0.3120	6.09	90.6
62	0.6164	7.22	107.2
57	0.4894	8.67	127.4
50	0.4280	10.77	150.2
50	0.3104*	10.48	174.7

*Strip separated after this reading

TABLE XXIII(continued)

Cell No. B 11

Admixture 0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
67	0.6670		0
67	0.9475	1.75	2.3
53	0.0197	5.21	6.9
52	0.0879	6.04	9.1
49	0.0633	7.39	12.3
49	0.2904	8.20	25.1
49	0.4996	8.92	40.7
49	0.5975	9.23	50.7
49	0.7248	9.62	63.9
49	0.7978	9.83	74.2
49	0.9457	10.24	88.2
49	1.0042	10.40	98.7
42	0.1995	10.63	115.4
42	0.3150	10.93	135.4
40	0.1697	11.22	158.2
40	0.3137	11.58	183.2
40	0.4695	11.95	217.7
40	0.5883	12.22	234.7
40	0.6432	12.34	266.2
40	0.6937	12.45	301.0
40	0.7378	12.54	326.2
40	0.7634	12.59	349.7
40	0.7943	12.66	379.2
40	0.8170	12.71	402.2
40	0.8390	12.75	420.9
40	0.8674	12.81	446.7
40	0.9027	12.88	468.4
40	0.9067	12.89	494.2
40	0.9433	12.90	517.2

Cell No. B 21

Admixture 0.1 N $CaCl_2$-0.01 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
70	0.0099		0
70	0.0240	0.05	0.9
70	0.0632	0.22	13.6
70	0.0980	0.37	29.1
70	0.1085	0.41	39.1
~~70~~	~~0.01170~~	~~0.45~~	~~52.6~~
70	0.1207	0.46	62.8
70	0.1120	0.43	77.1
72	0.3281	0.46	77.1
72	0.3654	0.61	86.4
72	0.3685	0.62	104.1
72	0.3683	0.62	124.1
72	0.3698	0.63	146.9
72	0.3798	0.67	171.6
72	0.3465	0.54	206.1
72	0.3870	0.70	223.1
72	0.3592	0.59	255.1
72	0.3482	0.54	289.9
72	0.3965	0.74	314.9
72	0.3704	0.63	338.1
72	0.4037	0.76	368.1
72	0.3726	0.64	391.1
72	0.3752	0.65	409.9
72	0.4045	0.77	435.4
72	0.3953	0.73	457.4
72	0.3898	0.71	483.1
72	0.3896	0.71	505.6

TABLE XXIII (continued)

Cell No. B 8

Admixture 0.1 N $CaCl_2$-0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
62	0.1342		0
62	0.3133	0.78	15.5
62	0.3806	1.06	25.6
62	0.4165	1.22	38.8
62	0.4896	1.51	49.2
62	0.5880	1.91	63.3
62	0.2924	0.69	73.8
62	0.5362	1.70	90.3
62	0.6406	2.11	110.5
62	0.6900	2.31	133.3
62	0.7312	2.46	157.9
62	0.7495	2.54	192.8
62	0.7902	2.68	209.3
62	0.8018	2.73	241.3
62	0.8065	2.74	276.0
62	0.8152	2.78	301.1
62	0.8611	2.94	324.8
62	0.8665	2.96	345.3
62	0.8590	2.94	377.3
62	0.8841	3.03	396.0
62	0.8777	3.01	421.4
62	0.9128	3.14	443.5
62	0.9270	3.19	469.3
62	0.9350	3.22	491.8

Cell No. B 5

Admixture 0.1 N $CaCl_2$-0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
84	0.1984		0
83	0.0802	0.84	3.5
82	0.0245	0.69	5.6
83	0.0711	0.12	8.8
83	0.1764	0.29	21.6
83	0.1939	0.35	37.1
83	0.2220	0.46	47.1
83	0.2403	0.53	60.4
83	0.3630	0.98	70.7
83	0.3217	0.83	84.9
83	0.2579	0.59	95.2
83	0.2512	0.57	111.9
83	0.2953	0.73	132.2
83	0.3162	0.81	154.7
83	0.2750	0.66	179.4
83	0.2572	0.59	214.4
83	0.3010	0.76	230.9
83	0.2713	0.65	262.9
83	0.2725	0.65	297.7
83	0.2921	0.72	322.7
83	0.3090	0.78	345.9
83	0.3206	0.83	375.9
83	0.2898	0.71	398.9
83	0.2969	0.74	417.7
83	0.2983	0.75	443.2
83	0.3292	0.86	465.2
83	0.3287	0.86	490.9
83	0.3359	0.88	513.7

TABLE XXIV

RESISTANCE DATA AND CALCULATED VOLUME LOSS FOR 6061-T6 ALLOY

Cell No. C 1 — Admixture None; Cell No. C 19 — Admixture 0.05 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours	Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
70	0.4974		0	70	0.5244		0
70	0.5077	0.10	7.7	70	0.5321	0.18	2.9
70	0.5088	0.11	22.5	70	0.5504	0.60	16.8
70	0.5123	0.15	34.6	70	0.5458	0.50	29.9
70	0.5176	0.20	49.1	70	0.5534	0.27	42.5
70	0.5057	0.08	48.9	70	0.5794	1.24	56.1
70	0.5290	0.31	76.2	70	0.5673	0.98	71.4
70	0.5454	0.46	97.8	70	0.5883	1.42	89.9
70	0.4389	0.59	119.0	70	0.5944	1.55	113.9
70	0.4550	0.43	142.7	70	0.5968	1.60	138.1
70	0.5590	0.54	167.9	70	0.5901	1.46	163.2
70	0.5546	0.55	196.9	70	0.5928	1.52	192.3
70	0.5542	0.55	214.7	70	0.5876	1.41	209.9
70	0.5721	0.71	238.4	70	0.5950	1.56	233.4
70	0.5792	0.78	262.8	70	0.5965	1.59	258.1
70	0.5682	0.68	286.6	70	0.5937	1.54	281.9
70	0.5666	0.66	310.8	70	0.5947	1.56	306.2
70	0.5880	0.86	345.9	70	0.6135	1.93	341.1
70	0.5805	0.79	367.5	70	0.6173	2.01	362.8
70	0.5950	0.93	388.2	70	0.6208	2.08	379.1
70	0.5914	0.89	406.3	70	0.6284	2.22	401.5
70	0.5892	0.87	431.6	70	0.6255	2.17	426.9
70	0.6042	1.01	454.5	70	0.6426	2.49	449.7
70	0.5851	1.33	478.3	70	0.6423	2.49	473.7

TABLE XXIV (continued)

Cell No. C 11

Admixture 0.05 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
77	0.5850		0
77	0.6062	0.37	21.1
77	0.6265	0.72	34.2
77	0.6206	0.62	46.8
77	0.6373	0.90	60.5
77	0.6581	1.24	75.8
77	0.6761	1.53	94.3
77	0.6876	1.70	118.4
77	0.7031	1.94	142.3
77	0.7128	2.08	167.5
77	0.7389	2.46	196.6
77	0.7428	2.51	215.2
77	0.7628	2.79	237.8
77	0.7768	2.98	262.4
77	0.7870	3.11	286.3
70	0.0672	3.17	310.5
70	0.0980	3.59	345.5
70	0.1157	3.81	367.1
70	0.1154	3.81	383.4
70	0.1368	4.08	405.9
70	0.1354	4.06	431.3
70	0.1705	4.48	454.1
70	0.1704	4.48	478.0

Cell No. C 16

Admixture 0.05 NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
70	0.4307		0
70	0.7838	2.92	7.3
70	0.8463	3.36	21.1
70	0.8572	3.44	34.3
70	0.9054	3.76	47.1
70	0.9358	3.96	48.5
70	0.9705	4.18	78.8
63	0.2758	4.64	97.5
63	0.3142	4.88	118.6
63	0.3808	5.29	142.3
63	0.4526	5.70	167.6
63	0.5550	6.26	196.6
63	0.6439	6.72	214.2
63	0.8114	7.52	237.9
56	0.2826	8.19	262.4
56	0.9212	10.91	286.2
50	0.5934	12.01	310.5
50	0.7113	12.30	345.4
50	0.7665	12.44	367.2
50	0.8189	12.56	387.9
50	0.8689	12.68	405.9
50	0.9255	12.80	431.2
50	0.9924	12.95	454.1
43	0.1755	13.09	478.0

TABLE XXIV (continued)

Cell No. C 10

Admixture 0.1 N $CaCl_2$-0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
70	0.2460		0
70	0.3227	0.73	13.8
70	0.3357	0.85	26.9
70	0.3526	1.00	39.6
70	0.3629	1.10	53.2
70	0.3745	1.20	68.4
70	0.3725	1.18	87.0
70	0.3701	1.16	111.1
70	0.3789	1.24	135.0
70	0.3784	1.23	160.3
70	0.4036	1.45	189.3
70	0.4055	1.47	206.9
70	0.4233	1.62	230.5
70	0.4460	1.81	255.1
70	0.4579	1.91	278.9
70	0.4585	1.92	303.2
70	0.4813	2.11	338.1
70	0.4758	2.06	359.9
70	0.4716	2.03	376.1
70	0.4738	2.05	398.6
70	0.4637	1.46	423.9
70	0.4851	2.14	446.8
70	0.4682	1.99	470.7

TABLE XXV

RESISTANCE DATA AND CALCULATED VOLUME LOSS FOR 5154-H34 ALLOY

Cell No. D 3

Admixture None

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
70	0.2202		0
70	0.2179	0.02	2.0
71	0.3330	0.06	11.8
71	0.3520	0.19	23.9
70	0.2368	0.12	37.7
70	0.2699	0.34	48.9
70	0.2563	0.25	59.5
70	0.2790	0.40	74.7
70	0.2874	0.46	84.4
70	0.2746	0.37	108.0
70	0.3049	0.58	134.1
70	0.2815	0.42	158.0
70	0.2971	0.53	182.0
70	0.2748	0.37	202.7
70	0.2967	0.52	227.3
70	0.3088	0.60	251.8
70	0.3207	0.68	275.5
70	0.3210	0.68	299.2
70	0.3305	0.75	333.2
70	0.3287	0.74	356.1
70	0.3295	0.74	371.0
70	0.3348	0.78	395.0
70	0.3313	0.75	419.4
70	0.3386	0.80	443.2
70	0.3500	0.87	472.7

Cell No. D 8

Admixture 0.01 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
71	0.4892		0
71	0.4850	-0.03	8.4
71	0.4980	0.05	11.9
71	0.5058	0.11	18.1
71	0.5095	0.13	30.4
70	0.4212	0.24	43.4
70	0.4305	0.30	55.1
70	0.4368	0.34	65.8
70	0.4319	0.31	81.2
70	0.4420	0.37	90.5
70	0.4504	0.42	114.2
70	0.4381	0.35	140.4
70	0.4327	0.31	164.2
70	0.4510	0.43	188.4
70	0.4502	0.42	209.0
70	0.4477	0.41	233.2
70	0.4568	0.46	258.3
70	0.4542	0.45	281.7
70	0.4650	0.51	306.4
70	0.4695	0.54	339.6
70	0.4554	0.45	362.4
70	0.4580	0.47	377.3
70	0.4584	0.47	401.4
70	0.4581	0.47	425.6
70	0.4413	0.37	449.5
70	0.4495	0.42	478.9

TABLE XXV (continued)

Cell No. D 2

Admixture 0.01 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
70	0.8167		0
70	0.8185	0.01	1.7
67	0.4944	0.02	5.3
63	0.0663	0.05	10.9
63	0.1006	0.23	23.7
63	0.0983	0.26	35.8
63	0.1294	0.47	48.4
63	0.1273	0.46	59.2
63	0.1525	0.62	74.4
63	0.1611	0.67	84.1
63	0.1776	0.78	107.8
63	0.2130	1.00	133.8
63	0.3106	1.60	157.6
63	0.3334	1.73	181.8
63	0.3310	1.72	202.4
63	0.3268	1.69	226.8
63	0.3216	1.66	250.4
63	0.3070	1.58	275.1
63	0.1997	1.69	298.9
63	0.3263	1.53	332.9
63	0.2983	1.53	355.8
63	0.2993	1.53	370.6
63	0.3047	1.50	394.7
63	0.3068	1.58	419.0
63	0.2966	1.51	442.9
63	0.3106	1.55	472.3

Cell No. D 24

Admixture 0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculared Volume Loss ($in^3/in^2 x10^3$)	Total Time Hours
70	0.3366		0
67	0.0845	0.41	1.5
67	0.0902	0.50	5.2
71	0.3382	0.60	11.3
71	0.3970	0.96	23.5
70	0.3175	1.11	35.6
70	0.5696	1.42	48.3
70	0.6023	1.60	59.0
70	0.6262	1.74	74.2
70	0.6506	1.87	83.9
70	0.6791	2.03	107.5
70	0.7313	2.31	133.6
70	0.7325	2.32	157.4
70	0.7946	2.64	181.5
70	0.7878	2.51	202.2
70	0.7683	2.51	226.6
70	0.8435	2.89	251.2
63	0.1526	3.25	274.9
63	0.1608	3.29	298.7
63	0.2457	3.71	332.7
63	0.2732	3.85	355.6
63	0.3018	3.99	370.4
63	0.3503	4.21	394.5
63	0.3955	4.43	418.9
63	0.4270	4.57	442.7
63	0.4948	4.87	472.1

TABLE XXV (continued)

Admixture 0.1 N NaOH Cell No. D 10				Admixture 0.01 N $CaCl_2$-0.01 N NaOH Cell No. D 9			
Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours	Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
67	0.2178		0	70	0.1170		0
67	0.2942	0.53	6.7	70	0.1280	0.07	4.8
67	0.3265	0.74	10.9	70	0.1368	0.13	9.0
67	0.3537	0.92	17.2	70	0.1483	0.20	15.3
67	0.4035	1.24	29.3	70	0.1687	0.33	27.4
63	0.0342	1.63	42.4	70	0.1909	0.47	40.4
63	0.0749	1.88	53.0	70	0.1955	0.50	51.7
63	0.0850	1.95	64.8	70	0.2050	0.50	62.8
63	0.1659	2.43	80.3	70	0.2114	0.59	78.4
63	0.2160	2.72	89.5	70	0.2212	0.65	87.6
63	0.2742	3.05	112.5	70	0.2278	0.69	111.2
63	0.3419	3.42	139.3	70	0.2332	0.73	137.4
63	0.4078	3.77	163.2	70	0.2593	0.88	161.3
63	0.4445	3.96	187.4	70	0.2567	0.87	206.1
63	0.5119	4.30	208.0	70	0.2360	0.74	230.1
63	0.4727	4.10	232.0	70	0.2505	0.83	254.3
63	0.5634	4.55	256.2	70	0.2512	0.83	278.8
63	0.5867	4.66	280.7	70	0.2558	0.86	302.6
63	0.5720	4.59	304.5	70	0.2793	1.00	336.8
63	0.5325	4.40	338.7	70	0.2633	0.90	359.5
63	0.6280	4.85	361.5	70	0.2606	0.89	374.3
63	0.6170	4.80	376.3	70	0.2846	1.03	398.4
63	0.6600	5.00	400.4	70	0.2875	1.05	422.7
63	0.6965	5.17	424.6	70	0.3308	1.30	446.5
63	0.7195	5.27	448.5	70	0.3552	1.44	475.9
63	0.7583	5.44	477.7				

TABLE XXVI

RESISTANCE DATA AND CALCULATED VOLUME LOSS FOR 5154-H34 ALLOY

Cell No. E 3, Admixture 0.01 N NaOH				Cell No. E 24, Admixture 0.05 N NaOH			
Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours	Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
63	0.1947		0	70	0.2784		0
63	0.2018	0.06	0.2	70	0.2765	0.02	0.7
63	0.2885	0.82	12.5	70	0.3108	0.30	11.7
63	0.2981	0.90	22.4	70	0.2995	0.20	21.6
63	0.3238	1.11	45.8	70	0.3182	0.37	45.1
63	0.3478	1.31	82.7	70	0.3393	0.56	82.0
63	0.3652	1.45	93.3	70	0.3516	0.67	92.6
63	0.4211	1.89	123.0	70	0.3869	0.98	122.2
63	0.4228	1.90	141.7	70	0.3590	0.74	141.0
63	0.4336	1.98	166.8	70	0.3854	0.97	166.1
63	0.4491	2.10	214.1	70	0.4307	1.36	213.6
63	0.4502	2.11	237.9	70	0.4308	1.36	237.2
63	0.4526	2.13	261.8	70	0.5278	2.14	261.1
63	0.4602	2.18	345.2	70	0.6193	2.83	344.4
63	0.4983	2.46	405.1	70	0.6964	3.38	404.3
63	0.5116	2.56	429.4	70	0.7168	3.52	428.7
63	0.4806	2.33	454.1	70	0.6998	3.40	453.4
63	0.5315	2.70	488.8	70	0.7690	3.87	488.0

TABLE XXVI (continued)

Cell No. E 19

Admixture 0.1 N $CaCl_2$

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
71	0.0888		0
77	0.7224	0.14	0.7
77	0.7465	0.36	13.0
70	0.0097	0.22	22.1
77	0.7353	0.26	46.5
77	0.7512	0.40	83.2
70	0.0376	0.48	93.8
70	0.0196	0.31	123.6
70	0.0150	0.27	142.3
70	0.0398	0.50	167.4
70	0.0321	0.43	214.9
70	0.0558	0.64	262.4
70	0.0442	0.54	345.8
70	0.0950	0.99	405.6
70	0.1028	1.05	430.0
70	0.1183	1.18	454.7
70	0.1104	1.11	489.3

Cell No. E 17

Admixture 0.1 N $CaCl_2$-0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
70	0.7515		0
70	0.7477	-0.04	0.6
70	0.8141	0.58	11.5
70	0.8085	0.53	21.5
70	0.8400	0.81	45.0
70	0.8806	1.16	81.7
70	0.8963	1.30	92.3
70	0.8980	1.31	122.1
70	0.8982	1.31	140.9
70	0.9196	1.49	165.9
70	0.9358	1.13	213.4
70	0.9510	1.75	260.9
70	0.9956	2.11	344.3
63	0.3023	2.69	404.2
63	0.3185	2.81	428.5
63	0.3468	3.03	453.2
63	0.3043	2.70	487.8

TABLE XXVI (continued)

Cell No. D 6

Admixture 0.1 $CaCl_2$-0.1 N NaOH

Decade Box (ohms)	Slide Wire	Calculated Volume Loss ($in^3/in^2 x 10^3$)	Total Time Hours
63	0.0854		0
63	0.0322	-0.36	1.8
63	0.0897	0.03	8.1
63	0.0142	-0.48	20.1
63	0.1473	0.42	33.1
63	0.2052	0.79	43.9
63	0.2177	0.87	55.7
63	0.2350	0.98	71.0
63	0.2700	1.20	80.4
63	0.2828	1.28	103.4
63	0.2907	1.32	130.1
63	0.3185	1.49	154.1
63	0.3312	1.57	178.3
63	0.3600	1.74	198.9
63	0.3863	1.89	222.9
63	0.4080	2.02	247.1
63	0.4284	2.13	271.4
63	0.4786	2.42	295.3
63	0.5506	2.81	329.4
63	0.6526	3.34	352.2
63	0.6787	3.48	367.1
63	0.7457	3.81	391.2
63	0.8136	4.14	415.5
63	0.9278	4.67	439.4
63	0.6862	3.51	468.6

TABLE XXVII

POTENTIAL MEASUREMENTS OF 6061-T6 ELECTRODES

Admixture	Current Density M A/in^2	Potential with Respect to Saturated Calomel Anode	Cathode	Total Time (Hours)
None	1.0	-1.37	-1.60	0
		49.5	-1.80	69
		51.5	-1.73	118
		72.0	-1.71	213
		83.5	-2.25	287
None	0.5	-1.27*	-1.78	0
		0.85	-1.70	69
		0.92	-1.64	118
		0.95	-1.64	213
		0.93	-1.66	287
None	0.2	-0.72	-1.72	0
		5.70	-1.61	69
		7.42	-1.62	118
		10.80	-1.63	213
		17.40	-1.57	287
None	1.0	-1.08	-1.9	0
		64.20	-1.84	118
		74.00	-1.76	144
None	0.5	-0.98	-2.02	0
		32.1	-1.77	118
		38.0	-1.68	143.5
None	0.2	-0.82	-1.80	0
		5.08	-1.60	118
		4.00	-1.68	142
None	1.0	0.75*	-1.85	0
		0.90	-1.95	47
		0.85	-1.88	72
None	0.5	-0.98	-1.88	0
		6.10	-1.75	47
		7.45	-1.70	72
None	0.2	-1.22	-1.75	0
		4.9	-1.60	47
		6.3	-1.55	72

*Mild steel anode used in place of aluminum.

TABLE XXVII (continued)

Admixture	Current Density M A/in^2	Potential with Respect to Saturated Calomel Anode	Cathode	Total Time (Hours)
0.1 N $CaCl_2$	1.0	-0.50	-1.85	0
		-0.21	-1.83	69
		-0.10	-1.81	118
		-0.06	-1.69	213
		-0.01	-2.45	287
0.1 N $CaCl_2$	0.5	-1.32	-1.72	0
		-0.09	-1.70	69
		-0.13	-1.71	118
		-0.09	-1.72	213
		-0.07	-1.72	287
0.1 N $CaCl_2$	0.20	-0.07*	-1.69	0
		-0.17	-1.60	69
		-0.10	-1.60	118
		0.13	-1.62	213
		0.11	-1.63	287
0.1 N $CaCl_2$	1.00	--	--	0
		-0.23	-1.78	118
		-0.26	-1.71	143
0.1 N $CaCl_2$	0.50	--	--	-
		-0.16	-1.70	118
		-0.23	-1.64	143
0.1 N $CaCl_2$	0.20	-1.00	-1.88	
		0.96	-1.58	
		0.03	-1.55	
0.1 N $CaCl_2$	1.0	-1.07	-1.77	0
		-0.39	-1.76	72
	0.50	-0.02	-1.73	0
		-0.18	-1.74	72
	0.20	-0.04	-1.80	0
		-0.18	-1.61	72

*Mild steel anode used in place of aluminum.

TABLE XXVII (continued)

Admixture	Current Density MA/in^2	Potential with Respect to Saturated Calomel Anode	Cathode	Total Time (Hours)
0.1 N $CaCl_2$ 0.1 N NaOH	1.0	-0.06*	-1.74	0
		0.28	-0.64	69
		0.34	-1.72	118
		0.77	-1.70	213
		0.87	-1.73	287
0.1 N $CaCl_2$ 0.1 N NaOH	0.5	-0.54	-1.74	0
		-0.08	-1.68	69
		-0.18	-1.64	118
		-0.30	-1.63	213
		0.02	-1.35	287
0.1 N $CaCl_2$ 0.1 N NaOH	0.2	-0.45	-1.61	0
		0.10	-1.60	69
		0.14	-1.63	118
		0.00	-1.62	213
		-0.17	-1.59	287
0.1 N $CaCl_2$ 0.1 N NaOH	1.0	-0.46	-1.86	0
		-0.29	-1.69	118
		-0.23	-1.67	144
0.1 N $CaCl_2$ 0.1 N NaOH	0.5	-0.46	-1.86	0
		-0.21	-1.69	118
		-0.23	-1.67	144
0.1 N $CaCl_2$ 0.1 N NaOH	0.2	--	--	0
		0.71	-1.60	118
		-0.06	-1.58	144
0.1 N $CaCl_2$ 0.1 N NaOH	1.0	-0.45	-1.78	0
		-0.34	-2.01	46
		-0.35	-2.47	72
0.1 N $CaCl_2$ 0.1 N NaOH	0.05	-0.02*	-1.73	0
		-0.22	-1.76	46
		-0.16	-1.73	72
0.1 N $CaCl_2$ 0.1 N NaOH	0.2	-0.02	-1.75	0
		-0.22	-1.63	46
		-0.16	-1.61	72

*Mild steel anode used in place of aluminum.

VITA

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