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Engineering Success

A newsletter from Biosystems and Ag Engineering Extension

Anhydrous ammonia application equipment

By: Randy Taylor, Extension Machinery Specialist

Uniformly distributing anhydrous ammonia across an applicator is a well-known challenge for the current technology of regulators and manifolds. With traditional systems a two-phase (liquid and gas) mixture of anhydrous ammonia is delivered from the metering system to the manifold. From the manifold, the outflow is divided between the individual outlets. Traditional systems typically have a high degree of variability across outlets and are not very precise when trying to accurately set the correct application rate.

Traditional regulator settings are adjusted by the "known weight-known area" method. This trial and error approach can be effective but is susceptible to larger errors. You can estimate the area covered and determine the application rate by using the known weight of an applied tank. However, point rows and implement overlap can introduce error into the area estimate. In addition to the previous factors, tank pressure can affect the regulator's accuracy.

Electronic controllers and ground drive pumps are options for replacing traditional regulators. These systems typically use a heat exchanger to keep anhydrous ammonia in a liquid form until it is metered. Cooling the main stream of ammonia helps keep the anhydrous ammonia in liquid form, providing a more accurate metering. These systems also keep the application rate fairly uniform as ground speed changes.

Standard cast iron manifolds will likely have non-uniform distribution if there is not back pressure in the manifold. There are at least three newer designs of manifolds that improve lateral distribution – Vertical Dam, Impellicone, and Equa-Flo. These are low cost, typically less than $400, items when considering the potential application errors of traditional systems.

Suggestions for Improved Lateral Uniformity

Based on research in the last few years, the following suggestions should improve lateral uniformity of current anhydrous ammonia delivery systems.

1. Install a pressure gage in the manifold, for improved monitoring of the system.

2. a) If using a conventional manifold, and manifold pressure is found to run below 30 psi, install orifice-type manifold hose barbs. The orifices should be sized to produce manifold pressures of 30 – 60 psi under normal operation. A common orifice size of 3/32" has been shown satisfactory for up to 100 lbs/ac at 5 mph on 16" knife centers.

OR:

b) Use a Vertical Dam, Impellicone, or Equa-Flo manifold with orifices sized correctly for the rates being applied. Manifold pressure will likely fall in the 30 – 60 psi range.

3. Assuming steps 1 and 2 are followed, the knife tube orifices can be removed by grinding. The cross-drilled knife orifices are a source of knife-to-knife variation due to burrs and other manufacturing irregularities. The full inside diameter of the knife tube can be used to deliver product, which reduces secondary hose pressure and lowers product discharge velocity. Under most conditions, this procedure greatly reduces the frequency of clogged knives.

4. If the first 3 steps are followed, hose lengths need not be the same for all knives. Pressure drop in the discharge hose becomes negligible in comparison to the pressure drop in the manifold orifices, therefore hose lengths can be chosen based on convenience of installation.

Find the fact sheet, Improving the Uniformity of Anhydrous Ammonia Application - by Iowa State University Extension, at
http://www.agmachinery.okstate.edu/ApplicationSystems/ImprovingUniformityAnhydrousAmmoniaApplication.pdf

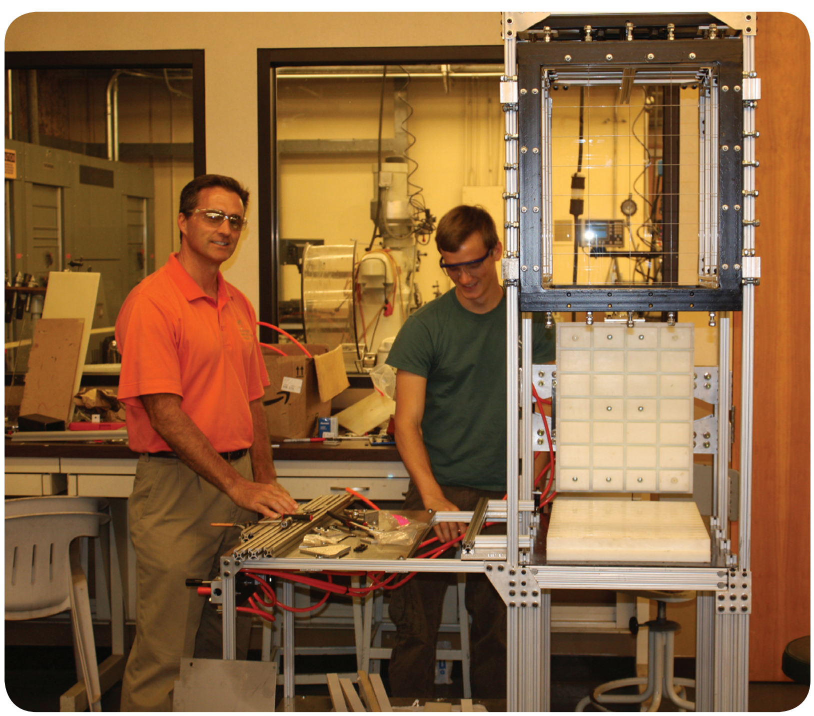
OSU Applications Engineering Program: Helping Oklahoma's manufacturers thrive for our rural communities

By: Doug Enns, Applications Engineer

When a manufacturer in Ft. Gibson could no longer produce enough of their product to keep up with demand they called engineer Win Adams for help. Using his vast knowledge of manufacturing operations, Adams assisted the manufacturer in designing a new production facility that was capable of efficiently meeting their growing production demands.

Adams is one of five application engineers working for OSU's Applications Engineering Program. Just as the university has been providing assistance to agricultural producers through Oklahoma Cooperative Extension Service offices for years, the Applications Engineering Program is providing engineering services to rural Oklahoma manufacturers. All five engineers are employees of the Department of Biosystems and Agricultural Engineering. Dr. Dan Thomas, Department Head for the Department of Biosystems and Agricultural Engineering, is co-principal investigator for the program along with Dr. Larry Hoberock, Department Head for the Department of Mechanical and Aerospace Engineering.

The Applications Engineering Program began in 1997 with a mission to improve the competitiveness and sustainability of Oklahoma's mostly rural manufacturers by providing them with on-site engineering assistance and technology transfer services. The program is a joint activity of the College of Engineering, Architecture and Technology and the Division of Agricultural Sciences and Natural Resources working in cooperation with the Oklahoma Manufacturing Alliance, a nonprofit organization based in Tulsa devoted to assessing the needs of manufacturers and linking them to the resources capable of fulfilling those needs.



The Applications Engineering Program focuses on rural manufacturing because the loss of a manufacturing facility in a small town can be devastating. When manufacturing jobs are lost, service industry businesses like doctor's offices, restaurants and grocery stores often follow. And, with the agriculture and energy industries no longer requiring the large labor forces that they once did, the loss of a manufacturing facility can result in a small town becoming a ghost town. By providing engineering support to these small to medium-sized manufacturers many of them have been able to not only survive but grow and become more and more competitive.

In fact, since 1997 the projects completed by the Applications Engineers have resulted in a \$310 million increase in sales, \$135 million retention in sales that would otherwise have been lost, \$92 million in cost savings, and \$112 million in new capital expenditures. The projects have also resulted in their clients being able to create or save over 3,700 manufacturing jobs. This is all according the manufacturers themselves as they complete a post project impact assessment survey. This impact assessment is done using procedures developed by the National Institute for Standards and Technology for the Manufacturing Extension Partnership. The client is contacted by a third party some months after the completion of an activity and is asked a series of questions designed to assess the impact of the engineering project.

The Applications Engineers assist manufacturers in implementing technical and engineering-based solutions to solve a wide range of problems. Typical projects might include using Lean Manufacturing principles to design new manufacturing facilities or improve the performance of existing facilities. The engineers provide assistance with process design, equipment design, equipment selection, failure analysis and product design. They are also capable of analyzing a manufacturer's energy use and then helping them develop a plan to reduce their energy costs.

The five engineers work together as a team relying on each other's expertise as needed. Adams is an industrial engineer based in Claremore and primarily serves the northeastern portion of the state. Shea Pilgreen is a biosystems and agricultural engineer located in Durant and covers the southeastern portion of the state. Don Lake is a mechanical engineer based in Weatherford and serves the western portion of the state. Both Doug Enns, mechanical engineer, and Rajesh Krishnamurthy, industrial engineer, are located on the Stillwater campus and provide support statewide as needed. These engineers work seamlessly with the Manufacturing Extension Agents of the Oklahoma Manufacturing Alliance to provide project framing and appropriate engineering assistance and technology transfer services.

A manufacturer seeking engineering assistance can contact their local Manufacturing Extension Agent or the Applications Engineer in their territory. For contact information and more news about the Applications Engineering Program and the Oklahoma Manufacturing Alliance visit **www.okalliance.com**.

Picture on previous page: Doug Enns, Sr. Applications Engineer, and MAE student, Thomas Buerger, complete the design and construction of a piece of equipment that will be used by a small Oklahoma manufacturer to increase production throughput.

Picture above: Applications Engineers Rajesh Krishnamurthy and Doug Enns provide engineering support to manufacturers in central Oklahoma.

Picture at left: Don Lake provides engineering assistance to Wilco Machine and Fab, Inc. in Marlow, Oklahoma.

Be sure to view the BAE news online for a recent OSU news release about how the expertise of these engineers has contributed more than $1 billion in total services and economic impact value to rural manufacturers in Oklahoma.
http://biosystems.okstate.edu/BAENews.html

Are you kidding?

You want to *grow* plants on the roof *in Oklahoma*!?!

By: Jason R. Vogel, Stormwater Specialist

The above question is often the first thing people think of when I mention using green roofs on buildings in Oklahoma. There are many good reasons for this reaction including wind, lack of rain, and temperature. However, a few examples of green roofs exist in Oklahoma and locations with similar environments, and research is ongoing to answer several important questions that must be addressed before green roofs will be widely accepted in our region.

What is a green roof?

Green roofs are vegetative systems that include different types and forms of plants which are installed on rooftops. In general, green roofs typically consist of a number of layers: structural support, a waterproofing membrane, a drainage system, root protection, growing media and vegetation (Figure 1, shown below) and may cover all or part of a building's roof.

Green roofs are generally categorized as extensive or intensive. Extensive green roofs are lightweight vegetated roofs consisting of 4-8 inches of growth media (soil), planted with hardy species to minimize irrigation, maintenance, cost and weight. Intensive green roofs may support lawns, trees, and even gardens. Intensive systems are often referred to as roof gardens. While these amenities do not preclude environmental benefits of green roofs, they do require extra structural support, involve greater depth of media and cost, and have functional goals in addition to stormwater management objectives. They also typically require supplemental irrigation systems. Green roofs can provide many different benefits. These benefits include:

- Insulation for the building to reduce heating and cooling costs
- Reduction of stormwater runoff volumes and peak rates
- Longer lifespan for the roofing system than conventional roofs
- Reduction in air temperatures around the building
- Aesthetic benefits that increase community acceptance and may add property value
- Recreational or garden space
- Increased urban habitat for birds and insects

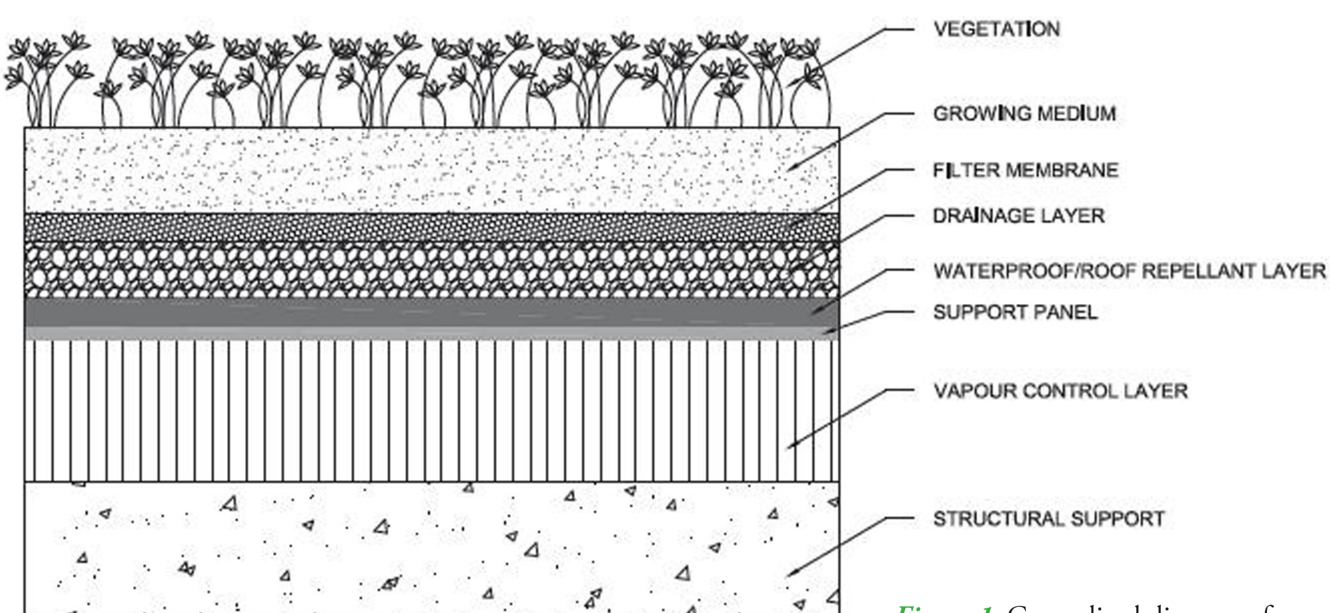


Figure 1. Generalized diagram of green roof layers.

Green Roof Questions for Oklahoma

For all of these benefits, however, there are also a number of questions that must be answered before green roof technology can be accepted and widely adopted in Oklahoma. The OSU Low Impact Development (LID) Program is working to address some of the questions regarding the use of green roofs in Oklahoma, which include:

- What native and well-adapted plants are viable and sustainable for green roofs in the region?
- What types and depths of soil media are appropriate for different plants on the green roof?
- How do geographic and climatic differences affect survival of plants on the green roof?
- What is the plant community succession on an unmanaged or managed green roof?
- What are the effects of high wind speeds and hail storms on the green roof?
- What are the active weed management requirements and effects on the green roof (mowing, pesticides, and mechanical removal)?
- Will green roofs be a fire hazard if installed on buildings in the region?
- What are the impacts of seasonal shadow changes found in urban environments on green roof plants?
- What are the potential energy savings of green roofs in different climates present in Oklahoma?
- What are the structural limitations of buildings in Oklahoma regarding green roof retrofits?
- How economically viable are green roofs in Oklahoma compared to more traditional roofing methods, taking into account ecosystem services, value of stormwater management and energy savings?

Figure 2: Experimental green roof at the National Weather Center in Norman.

Addressing these questions will require collaboration across campus and with other universities. One of these collaborations is with the University of Oklahoma to study plant survival, water retention, energy reduction, and glare reduction on an experimental green roof at the National Weather Center in Norman, Okla. (Figure 2, pictured above). The instrumentation installation at this site is ongoing, so be on the lookout in the future for results of these studies.

Recently Katie Beitz, graduate of the environmental science master's degree program, completed a study focused on the viability of using Buffalo Grass on green roofs in climatic conditions representative of Oklahoma summers. This project included researchers from the Department of Biosystems and Agricultural Engineering and the Department of Horticulture and Landscape Architecture at OSU. Her results show that using Buffalo Grass on green roofs in Oklahoma is possible, but it will require supplemental irrigation to prevent the grass from dying.

Whitney Lisenbee, BAE junior, is also beginning a Wentz Undergraduate Research project in fall 2011 to test plant growth in lighter weight growing media designed for use on an array of building types.

Answers to our questions regarding green roof utilization in Oklahoma will take time, but we are making progress. For more information on green roofs, please visit the OSU LID website at **http://lid.okstate.edu/green-roofs**.

Round Bale Hay Storage

By: Raymond L. Huhnke, Extension Agricultural Engineer

The 2011 drought has shown us how important forages are and has certainly increased their value. Proper hay storage can help reduce losses in a year where forage supplies are short. All forages packaged in large round bales benefit from protection while in storage. However, there are several factors that must be considered in justifying the cost of providing this protection. These factors include hay value, projected in-storage losses, local environmental conditions, and where the hay will be used. Bales should be stored in rows, butted end-to-end, and oriented in a north/south direction. The combination of the north/south orientation and at least three feet between rows will provide for good sunlight penetration and air flow, which will allow the area to dry faster after a rain. If round bales are stored outside and unprotected, losses can be greatly reduced by storing only those bales that are well-shaped with dense outer layers; keeping bales off the ground to eliminate wicking; and using these bales before spring warm-up to avoid excessive weathering.

View the fact sheet at http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1772/BAE-1716web.pdf

Subscription request

To receive a copy of the Engineering Success: A newsletter from OSU Biosystems and Ag Engineering Extension, e-mail Randy Taylor at randy.taylor@okstate.edu with **BAE Newsletter** in the subject line.

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