No weeping over this system

By Diane Mettler

The downstream end of the primary weeping wall system. The effluent leaving the system is conveyed to a concrete tank where a pump conveys the effluent to the secondary weeping wall system for further treatment. Photos by Deanne Meyer

Sierra Dairy of Dublin, Texas, realizes multiple benefits from its weeping wall waste management system

The Sierra Dairy, in Dublin, Texas, underwent an extensive expansion from 2005 to 2008. The farm's owners, the VanderHorst family – Alan, his wife Becca and their five children – transformed the 1980's era 1,000-head, open stall barn dairy into a 3,500-head free stall barn facility. The dairy now boasts a 60-cow rotary parlor, a flush system and an economical and innovative weeping wall waste separation system.

The dairy was already familiar with weeping wall systems. They had a smaller-scale system at another dairy and believed a larger version would work well for Sierra.

"One of the things we really like about the weeping wall system is that it uses gravity over any kind of electrical power," says Lance Reeves, operations manager at Sierra Dairy. "So, it requires little maintenance."

A flush system for 3,500 cows equates to roughly 250,000 to 300,000 gallons of water flushed per day. To handle that kind of volume, the dairy turned to Agricultural Engineering Associates (AEA) to design a state-of-the-art system.

Achieving goals

While designing the system, AEA were mindful of the Sierra Dairy's goals. First was to recycle as much sand as possible for bedding.

"We were also looking for economy, ease of construction as well as the ability to lower the moisture content of the settled manure solids so that the solids could be easily loaded out," says Jeff Murphy, staff engineer at AEA.

The design AEA developed allows the dairy to:

- Recycle up to 75 percent of the sand.
- Reuse the flush water.
- Economically separate solids and liquids for spreading and irrigation.
- Separate most of the phosphorous in the form of manure solids, so it can be spread farther from the dairy.
- Spend less time on maintenance compared to a mechanical separation system.

Sand settling basin

The system is primarily gravity fed. The water is flushed through the free stall barns four times a day and travels first through a sand-settling channel.

"It is sized with the right width and slope to bring the effluent flow to the right velocities to allow settling of sand, but keeps manure solid in suspension," says Murphy. "They clean the sand out of the channel with the loader, spread it out, and allow ultraviolet radiation to reduce bacterial counts. Then they reuse it for bedding in the stalls."

Dr. Saqib Mukhtar, a PhD and associate professor of Biological and Agricultural Engineering with Texas AgriLife Extension, has been out to do studies on the system and is impressed. "This is one of the very few dairies where I have seen a nicely, properly designed shallow, but narrow, long and effective, sand settling basin," he says.

Solid settling channel

The effluent travels to two of the four primary cells or basins. Each cell is 40-feet x 300 feet x 8 feet deep, with a capacity of approximately 718,000 gallons. (Combined, the four cells hold approximately 2.9 million gallons.) Inside the cells, the water "weeps" from the vertical slots in the walls, separating the water and solids via gravity. What makes these cells unique is that they are some of the first to have holes at the bottom to allow even more liquids to escape.

"Having multiple basins allows you to alternate which ones you're filling," says Murphy. "So while you're filling one, the other one that's just been filled can be dried and cleaned out and be ready to be filled again."

Once the water seeps from the first cells it's then pumped to a set of secondary cells, which are identical to the primary, just smaller.

Normally the secondary cells would be gravity fed. "But in this case, the footprint of these two systems is so large that they couldn't build a secondary system downstream from the primary," explains Mukhtar. "So they have to expend this extra energy."

The key component

The water that weeps from these secondary chambers is either pumped back up to tanks on top of the barn, where it will be used for flushing out the stalls, or gravity fed to liquid manure storage ponds (also referred to as lagoons), where the water will be used for irrigation.

"The key factor that makes this system work well and really makes it user friendly, is that we don't bring any water back from the lagoons," says Reeves. "Once our excess flush water leaves the secondary and goes to the lagoon it never comes back."

He adds, "The benefit of that is we don't have to keep our lagoons full so we can get good flush water. We can basically pump them dry and it doesn't affect us. It really opens up the possibilities and really doesn't tie you to managing your lagoons to your flush systems"

The flush water stored in the storage ponds is used to water crops during the growing season. "We cut fresh grass off our fields daily during the growing season and bring it back in here as feed," says Reeves. "And we have five lagoons – the largest being 82 acre-feet – so we've got a lot of storage."

The water recycling system is so efficient that the only fresh water that's added comes from the natural process water from the parlor.

Removing the solids

It takes approximately 60 to 90 days to fill two primary basins. Once they're full, the system switches to the other two primary basins and the solids in the first two are allowed to dry out for another 60 days.

Dr. Mukhtar says that the separated

Dr. Saqib Mukhtar points out the weeping wall features to the attendees of the Southwest Dairy Day at the Alan VanderHorst dairy near Dublin, Texas.

Looking upstream at the primary weeping wall. The sand settling lane runs along this weeping wall. The ramp to remove settled sand from the channel, and the recovered sand (foreground) and the stockpiled dried sand to be recycled as free-stall bedding are visible in this picture.

material, once dried, is normally at about 30 to 35 percent solids and about 65 to 70 percent moisture. At that consistency, liquid is no longer running out freely.

When the solids are dry enough to remove, the end walls of the basins are removed – lifted out with the loader and set to the side. This allows dozers and skid steers to drive directly into the basin to clean it out.

Although the walls are also a unique feature of this system, it's one thing the dairy wouldn't do again. "We would make it a ramp system," says Reeves. "The removable walls have probably been the Achilles heel of the whole thing. They tend to break and just moving them in and out is labor intensive – plus they're very fragile. They're not really made to be moved."

As for the spreading of the solids, Sierra Dairy hires a custom spreader to apply the solids to the dry land fields.

In fact, one of the highlights of the project has been the dryness of the product, says Reeves. "It's very easily handled and loaded in trucks. Since it's a drier product, versus the Honey Vac that we used before the expansion, we're able to truck it farther distances to some of our other fields. It's a lot less expensive because we're not hauling water."

Although there aren't likely to be odor complaints near a dairy town like Dublin, they have been lessened. "The odors are reduced by separating the solids from liquids and taking the liquids to the storage pond where they're diluted," says Dr. Mukhtar. "The odors are reduced because you are also removing some of the volatile compounds with the separated solids in the weeping wall basins and storing them. And also being drained and dried, the lesser the moisture, the better the aerobic conditions, and lesser the odors."

Final effluent leaving the chambers of the secondary weeping wall. This liquid is conveyed to lagoons for storage and treatment. Lagoon liquid is then used for flushing the manure alleys in free-stalls.

Planning for a system

Dr. Mukhtar says the weeping wall system isn't for every dairy. Anyone planning a new waste management system or treatment system needs to look at the entire picture. "They need to ask themselves, 'What is the objective? Is there enough land? Are they going to add some value by separating solids? Should I use those solids for composting? Would there be a market for that?'"

He adds, "For example, you can compost, and properly composted manure is an excellent source of fertilizer and organic matter, but if you can't utilized on your cropland and there is no one living within 30 miles and no one is willing to come in and pick it up (hopefully buy it), you're adding another stream of labor intensive manure that you then need to tackle."

In this case, the weeping wall system has been an ideal solution and Reeves believes it's something farms should look into. For Sierra Dairy, the system is paying for itself – in part it's able to recycle much of its bedding.

"Not a lot of people are pushing it because there are no replacement parts to sell and no service to sell," says Reeves. "Not everyone wants to hear that. But the manufacturers generally try to push things that are going to make them money in the long term. And this isn't one of those systems because it's an up front investment. And there's not a lot of money or maintenance to be spent on it down the road."

Dr. Mukhtar presented his findings on the efficacy of the Sierra Dairy weeping wall as a solid-liquid separation system at the Texas Animal Manure Management Issues (TAMMI) Conference held Sept. 29 and 30, 2009 at the Austin Marriott North in Round Rock, Texas.

The TAMMI Conference provided education and information on proper animal manure management for environmental protection and a thriving animal industry in Texas, in the context of evolving regulatory and public relations environment. Continuing education units will be available to participants. For more information, see the TAMMI website at http://grovesite.com/tamu/tammi. MM

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Study shows nitrous oxide now top ozone-depleting emission

Nitrous oxide has now become the largest ozone-depleting substance emitted through human activities, according to scientists with the National Oceanic and Atmospheric Administration (NOAA).

A study by the NOAA evaluated nitrous oxide emissions from human activities in terms of their potential impact on Earth's ozone layer. As chlorofluorocarbons (CFCs), which have been phased out by international agreement, ebb in the atmosphere, nitrous oxide will remain a significant ozone-destroyer, the study found. Today, nitrous oxide emissions from human activities are more than twice as high as the next leading ozone-depleting gas.

Nitrous oxide is emitted from natural sources and as a byproduct of agricultural fertilization. In addition to soil fertilization, nitrous oxide is emitted from livestock manure, sewage treatment, combustion and certain other industrial processes.

The study was authored by A.R. Ravishankara, J.S. Daniel and Robert W. Portmann with NOAA's Earth System Research Laboratory (ESRL) chemical sciences division.

"The dramatic reduction in CFCs over the last 20 years is an environmental success story. But manmade nitrous oxide is now the elephant in the room among ozone-depleting substances," said Ravishankara, lead author of the study and director of the ESRL Chemical Sciences Division in Boulder, Colo.

Though the role of nitrous oxide in ozone depletion has been known for several decades, the NOAA study is the first to calculate that role using the same measures that have been applied to CFCs, halons and other chlorine- and bromine-containing ozone-depleting substances.

In nature, bacteria in soil and the oceans break down nitrogen-containing compounds, releasing nitrous oxide. About one-third of global nitrous oxide emissions are from human activities. Nitrous oxide, like CFCs, is stable when emitted at ground level, but breaks down when it reaches the stratosphere to form other gases, called nitrogen oxides, which trigger ozone-destroying reactions.