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Wastewater Geomembrane Cover Floats Away Problems

As one of Canada's biggest and oldest manufacturers of corn-refined ingredients, Casco, Inc. serves 60+ industries, from food and beverage to pharmaceuticals to paper manufacturing and animal nutrition. Combined, its three Ontario manufacturing facilities process 4.5 million bushels of corn each month.

One plant, located in the town of Cardinal, directly on the St. Lawrence River, is among the most automated corn wet milling facilities in the industry. Processing 70 million lb of corn monthly, the facility manufactures high fructose corn syrup, glucose, specialty starches, and corn oil for Canadian and U.S. markets. This high-volume, 24/7 operation needs to process a continuing effluent of organic waste. A total average volume of 792,000 gal of wastewater per day enters its treatment facility, with 80% of this effluent first processed through its anaerobic digester. In essence, anaerobic digestion is a renewable energy source which converts wastewater to a methane- and carbon dioxide-rich biogas suitable for energy production, replacing fossil fuels.

Floating Geomembrane Cover Streamlines Biogas Collection

The Casco Cardinal plant has used a geomembrane cover on its bulk volume fermenter (BVF) bioreactor since it became operational in 1988. In October 2008, however, Casco upgraded to an improved design: a floating, insulated geomembrane cover with a streamlined capability to collect biogas. The cover captures and reclaims all of the biogas from the treatment process that is going on inside the anaerobic tank -- biogas that otherwise would be released to the atmosphere.



Designed, built and installed by Geomembrane Technologies Inc. (GTI), this new geomembrane cover is collecting an average of 236,000 cu ft of biogas per day from the BVF bioreactor at a 65% methane concentration.

"Over the past two years, Casco's cover was getting to the point where it needed to be revamped or changed," says Victor Cormier, engineer and Casco project manager for GTI (see old cover, right). "As the previous cover aged over the 20 years that it had been in place, it began to have issues inhibiting biogas collection. Our latest floating geomembrane cover system is significantly different from the previous cover. The prior cover fluctuated up and down with the wastewater level inside the tank. The new-design GTI cover system is a trampoline type: it has no folds and the material is quite taut."

New Cover Construction

The new cover (shown below) is made up of a 1 in. layer of polyethylene foam laminated to polyethylene sheeting on the bottom (wastewater-facing) side. The top layer is a non-laminated sheet of 40 mil specialty PVC (ethylene interpolymer alloy) that acts as a gastight barrier to keep the biogas from passing through. It also incorporates a highly specialized weave design that provides maximum strength-to-weight ratios. Since this top sheet is exposed to the sun, it is also equipped with advanced UV inhibitors.

The cover's polyethylene sheeting and insulation are not meant to be gastight – they are specially perforated to allow the biogas to pass through and become trapped by the top layer. This design has exceptional seam strength, extreme puncture and tear resistance, low thermal expansion and contraction properties, a wide range of chemical resistance, high flexibility, and dimensional stability under high loads and temperature fluctuations, making it ideal for anaerobic bioreactor floating cover applications.



The geomembrane cover lies on the surface of the bioreactor, which provides buoyancy for the cover system. It works under a vacuum, using a blower system which keeps the gases withdrawn and suctioned underneath the cover. The system incorporates a novel floating-beam design which not only assists in the initial deployment of the cover panels over large bioreactors (such as at Casco), but also creates a tent-like effect, giving extra migration paths for the biogas to follow. The beams themselves are hollow molded plastic, but they are also biogas-tight. Aluminum angles are bolted down to all panel sides of the cover to make a gastight seal, and a very strong connection so the panels maintain a

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constant vacuum.

Not all cover designs work this efficiently. Polyethylene top sheets, for example, typically have a poor coefficient of expansion and contraction. When it gets cold the material contracts, and when it gets warm it expands. Over time, this growing and shrinking distorts the cover shape, creating a series of hills and valleys that will inhibit biogas migration and collection, not to mention creating ponds of rainwater. GTI's cover system has overcome these deficiencies.

A customized control system for the gas collection and management uses a PLC in communication with SCADA (Supervisory Control and Data Acquisition) control software with a PC operator interface. The software trends operational data, and Casco operators can remotely monitor and control the system.

Improving BVF Heat Retention

The efficiency of the BVF bioreactor – its ability to maintain digestion of the continuously incoming influent and its commensurate production of biogas – is critically dependent upon keeping the temperature of the BVF reactor at 25 to 32°C. This is particularly important in cooler, northern climates. Heat loss in large volumes of wastewater translates to energy loss, and this lost heat must then be compensated for by adding heat. Casco has supplemented its BVF reactor with heat generated from its refinery wastewater, which has been intentionally heated to maintain the bioreactor's temperature.

Its new GTI geomembrane cover design provides a heightened level of insulation material to better hold heat within the reactor, and its snug fit reduces heat loss to a greater extent than the previous cover. Additionally, elimination of water evaporation and increased prevention of sunlight penetration improve maintenance of appropriate water temperatures. Minimizing heat loss and preventing potential ice buildup in the BVF has decreased Casco's energy consumption and reduced its operating costs.

Averting an Unplanned Biogas Release

Control of an unplanned biogas release and its attendant hydrogen sulfide-generated odor prompted Casco to move forward with the new upgraded geomembrane cover. Government standards do not allow any methane to be released to the environment from the plant, so the company needed to be certain that the GTI cover would meet these standards. Complicating the problem, the bioreactor is just 150 ft from a residential neighborhood, where a leak could present a serious safety hazard.

"GTI had been doing regular inspections for us as part of their service on the original cover," says Gerald Morand, process engineer and environmental coordinator for Casco. "Their technicians advised us that the cover had become quite thin in a number of areas, and that it was getting to an imminent point where it could fail. That is when we made the decision to replace it. In addition to the serious environmental and neighborhood safety implications, our operators were now limited from walking out onto the cover to measure the sludge levels. We deemed that the condition of the cover made it unsafe to take these measurements."

Challenging Cover Switch

Aside from a very tight deadline required to replace the cover because of the possibility of an unplanned, and potentially dangerous biogas release – the GTI design, manufacturing and installation team was required to complete the project in less than three weeks – a critical factor was the need to execute the Casco cover switch while still operating the plant. This meant that the wastewater flow from manufacturing could not stop. The solution implemented was to divert some of the plant effluent away from the BVF bioreactor to the aerobic lagoon while the work was in progress.

"We were concerned with the activity of the BVF unit while the cover was off," continues Morand. "Because the bioreactor runs anaerobically, when it is exposed to the air we expected it to have a decrease in activity, so we did not want to overload the system. If we could decrease the COD going to the BVF it would not put too much of a strain on the system while it was exposed to the atmosphere, yet still allow it to have some nutrients so that the biological activity would remain active. We cut the wastewater volume to the BVF by 55%, and we overloaded the aerobic lagoon intentionally during the project to reduce the biogases in the digester while we had the cover off."

Since the bioreactor is directly adjacent to the St. Lawrence River, only 25 ft of clearance was available on three sides of the system. The fourth side is bordered by the plant's operating railroad line, again minimizing available space. This posed challenges with both removing the old cover and installing the new one.

To remedy this, GTI manufactured and transported the 130 x 410 ft cover in four large sections, folded and rolled. The rolls were placed directly onto the BVF water, one at a time, opened, and connected using the GTI floating-beam design.

"The floating beams allowed us to connect the large cover panels together without having to weld them," Cormier continues. "We minimized the use of heat, because we did not want to ignite the biogas. The more we could do mechanically to fasten the large floating panels together without the use of electrical tools or heat, the safer the installation."

"GTI used a combination of a large crane, fork lifts and dump trucks to help maneuver the cover sections,"

explains Cormier. "While we were removing pieces of the old cover, we were simultaneously installing sections of the new cover to limit the reactor exposure to air and reduce the amount of odor coming off the wastewater. Usually, we remove the old cover, and install the new one by pulling one off while we are pulling on the other. In this case, because there was too limited space, we had to design, build and install the new cover differently."

Casco's new GTI floating geomembrane cover is not only successfully retaining the digester's biogas odors, and delivering a very efficient system for the collection and management of biogas, it is also providing a strong surface to safely support foot traffic. "We are quite happy with GTI, and felt comfortable working with their team," Morand says. "They had the most intimate knowledge of our system and situation. The entire project went smoothly."

"Companies are looking for both wastewater and freshwater cover systems that are environmentally proven, energy efficient, and essentially maintenance free," says Hollis Cole, president and CEO of GTI. "This requires extensive research and development into new techniques and products, and a commitment to quality and performance. Floating, insulated geomembrane covers represent the most advanced level of this technology, especially when applied to anaerobic wastewater systems."

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