CASE STUDY

THERMO-SYSTEM®

Palma de Mallorca, Spain

Energy efficient, solar sludge drying for large treatment facilities

Overview

Mallorca is one of several islands in the western Mediterranean Sea, approximately 60 miles off of the east coast of Spain. With its beautiful landscape and mild, sunny climate, Mallorca is a very popular European tourist destination. Palma de Mallorca is the major city on the island and the capital of the local Spanish province. Considering the heavy tourism, Palma de Mallorca has a population equivalent to approximately 600,000 people. Currently, the drying facility is receiving sludge from approximately 20 local wastewater treatment plants with the combined flow of 40 MGD.

Challenge

In recent years, political opposition as well as a lack of popular support by the general public has led to a significant decline in the agricultural utilization of sludge on the island causing the city to look for alternative disposal methods. High costs made transportation to the Spanish mainland prohibitive, thus forcing the city to find a method for suitable disposal on the island itself. Finally, the island's dependence on tourism demanded a flexible, environmentally friendly solution.

Steps Taken

The City of Palma evaluated multiple technologies to address their sludge drying needs. Composting, convential gas-fired thermal dryers and the THERMO-SYSTEM® Active Solar Sludge Dryer were all reviewed in great detail as possible technological solutions.

Composting was not chosen because of the complexity of the process and the relatively large volume of final product the process produces. Composting would require incoming sludge dry solids be around 45-55% dry solids. Since most waste water sludge is in the 10-20% dry solids range, this would require the operator to add a significant amount of dry, biological "bulking" material such as straw or wood chips. This would add significant volume to the end product thus increasing hauling costs and, depending on the bulking agent used, disposal options could be limited.

Gas fired thermal dryers were thoroughly reviewed as a viable sludge drying solution. However, it was found that these dryers had intensive energy usage and therefore would require high operating costs and not be environmentally friendly.

Solution

Lower operating costs, along with the inherit safety and environmental friendliness of solar drying made the THERMO-SYSTEM® Active Solar Sludge Dryer the clear choice for Palma De Mallorca's sludge treatment.

The heat needed for the drying process currently comes solely from the sun, however there are plans to utilize surplus heat from a local biogas power station in the future. This biogas power station is capable of producting approximately 1.5MW (mega-watts) of electrical energy and an additional 1.5MW of thermal energy in the form of engine cooling water. Three of the drying chambers are equipped with water-to-air heat exchangers for utilizing this cooling water, which will further reduce the drying time in these chambers. Two air scrubbers were also included in the design to prevent odors resulting from the occasional drying of non-stabilized sludge.

ENERGY COST COMPARISON GAS VERSUS SOLAR		Thermal Dryer		THERMO-SYSTEM®	
Energy Type	**Basis**	**Annual Usage**	**Annual Cost**	**Annual Usage**	**Annual Cost**
Thermal Energy (Oil Equivalent)	$130/barrel	13,000 barrels	$1,690,00	0 barrels	$0
Electrical Energy	13¢/kWh	2,957,000 kWh	$257,000	686,000 kWh	$89,00
Total Annual Operating Cost (Energy Only)		$1,947,000		$89,000	
Thermo-System Annual Savings				**$1,858,00**	

When the desired final dry solids content has been reached, the PLC alerts the operator drying is complete. From there the dried sludge is loaded directly into trucks by front end loaders and taken to a neighboring waste-to-heat power station for beneficial reuse as a fuel source.

Implementation

The implementation process went quite smoothly. A trusted partner was chosen for construction of the drying chambers which led to good communication and a high quality of work. The only implementation issue centered around the chemical air scrubbers that were designed based on the assumption that a large volume of air would need to be moving through them at all times during the drying process to avoid any possibility of odors. A key component of the THERMO-SYSTEM® drying process is high air flux rate through the drying chamber and an air scrubber that is too large reduces this air flow due to pressure drop. Through close work between product engineers and plant operations, it was determined that it was only necessary for exhaust air to flow through the scrubber system for the first three days of a new sludge batch. After this time, enough drying and stabilization had occurred, allowing the operators to exhaust to the environment with no odor issues. Under these conditions, no more than three drying chambers needed air scrubbing at any given time. The end result was proper air flow through the drying chambers and no odor issues.

Tecnical Data

Sewage plant	Size:	Combined 40 MGD
	Sludge quantity:	33,000 tons/year with 20-30% DS
	Stabilization:	Variable
Drying	Target DS:	60-80% DS year round
	Dry material:	Approx. 11,000 tons/year
Plant Data	Total Area:	215,000 ft2
	Structural skin:	Single-pane safety glass (4 mm) / Insulated glass (16 mm)
	Waste heat input:	0 to 500 kW

Results

The THERMO-SYSTEM® active solar sludge dryer has produced the following results for the city of Palma De Mallorca:

- Low Staffing Costs – because the drying process is fully automated and controlled by a PLC the facility only needs two operators on duty and these operators do not need to be highly trained. They only need to know how to operate a front in loader.
- Low Operating Costs and No Adverse Environmental Impact – the primary source of energy for drying the sludge comes from the sun; a free energy source without the CO2 production that comes from burning fossil fuels like natural gas. The chart above shows estimated cost savings seen by the city as a result of choosing the THERMO-SYSTEM® instead of a gas fired thermal dryer.
- Reduced Hauling Costs – The THERMO-SYSTEM® reduced hauling costs by approximately 75% by reducing the volume of sludge by an equal amount through the drying process.
- Waste to Energy – Once dried to 75% dry solids, the heating value of the sludge is approximately 5000 BTU/lb which is approximately the same as raw brown coal. This allows the city to burn the material in the neighboring waste-to-energy power station and generate electricity.

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