On-site incineration of sewage sludge

Landfilling and land application of sewage sludge is no longer permitted in some countries and incineration remains the only viable method for sludge disposal. Sludge is commonly incinerated in large central plants or, as an additive, in coal fired power stations or in cement kilns.

We offer another option: small, local sludge incinerators. Sludge incineration at the treatment plant provides the following advantages:

- sludge transportation is avoided,
- other solid waste, such as screenings or bio-waste, can be incinerated together with the sewage sludge,
- locally generated power substitutes expensively purchased power,
- co-generated heat is used on site for sludge drying and
- wastewater treatment plant operators remain independent of large power companies and their price increases for sludge incineration.

The HUBER sludge2energy system includes our medium-temperature belt dryer. Hot dryer air is drawn by blowers through the slowly moving belts and the sludge layer thereon. The hot dryer air absorbs water and is thus cooled. Most of the air is re-circulated and blended with a smaller flow of preheated ambient air. The blended dryer air is then heated to around 130 °C with heat from the sludge incinerator before it is drawn through the sludge. Some of the dryer air is drawn by another blower out of the dryer thus keeping the entire dryer at a slight under-pressure to prevent dryer air, odour and vapour from escaping. This exhaust air is cooled in a heat exchanger whereby the extracted heat is used for preheating the incoming atmospheric air. Vapour condenses in the heat exchanger and the water is returned to the treatment plant. The exhaust air is further cooled and cleaned in a scrubber.
The dried sludge has a solids concentration of about 90 % and is fed with a screw conveyor into a small furnace that is similar to those commonly used for biomass combustion. The hot flue gas flows through a pebble heat recuperator that transfers heat to compressed ambient air. The hot and compressed air drives a micro gas turbine and a generator. Because of direct gas-to-air heat transfer no water-vapour cycle is required. Even small systems can produce electricity with an efficiency of around 30 % and well over 50 % of the energy is recovered through heat exchangers for sludge drying.

The pebble heat recuperator consists of a pair of vessels that are filled with pebbles. Hot flue gas and compressed atmospheric air are blown sequentially through the vessels. The hot flue gas with a temperature between 900 and 1000 °C is cooled in one vessel and heats the pebbles. At the same time, in the other vessel, the pebbles are cooled and transfer their heat to the compressed atmospheric air. The air is heated to over 900 °C. When the temperature difference between the flue gas and the air exceeds a certain level, the gas and air flows are switched to the other vessels. In this way, the pebbles are sequentially heated and cooled, thereby transferring up to 98 % of the heat from the flue gas to the atmospheric air. The incoming atmospheric air is compressed by the micro-turbine to around 4 bar and heated to about 200 °C. The air is then cooled in a heat exchanger whereby the heat is recovered to pre-heat ambient air entering the sludge dryer. Alternatively, some water can be injected and evaporated, thus cooling the compressed air and increasing the flow. While the compressed air passes through the hot pebble recuperator, it is heated to over 900 °C and expands. Its now much larger volumetric flow drives the micro-turbine whereby it expands further while its pressure drops. The expanded air has now a temperature of about 600 °C and is further cooled in heat exchangers transferring heat to the sludge dryer. The still warm air is blown as combustion air into the sludge furnace.

Formation of nitroxides is prevented by staged combustion, flue gas recirculation and selective non-catalytic reduction. The flue gas, after it has been cooled and screened in the pebble recuperator, enters a further gas cleaning system. Acidic gases, such as SO2 and HCl are neutralized and removed by addition of lime to the exhaust gas. Remaining organic components, such as dioxins and furans, as well as volatile heavy metals are removed through adsorption on activated carbon. Fly ash and other particles are finally removed with filter elements. The elements are made of a special material that is resistant to chemicals and a temperature as high as 350 °C. It is coated with an inorganic material to guarantee long life and low flow resistance. The exhaust meets the stringent German requirements. Together with the ATZ we are presently designing our first sludge2energy® demonstration plant for the Bavarian city Straubing. This first plant will have a capacity to incinerate 2,200 tons of sludge dried solids per year and will generate 100 kW of electrical power.