MOLYREVIEW

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Heating homes with household waste

Photo: JM Tremil/ SYCTOM

Located only minutes from the Eiffel Tower, a new waste-to-energy plant recently started operation in Paris. The plant uses the waste of more than one million households to produce heat and power for many homes here. It operates in a way that saves energy and is friendly to the environment and its neighbors. Molybdenum-containing materials are used throughout the plant to ensure the reliability of processes at high temperatures and in highly corrosive environments.

Just outside Paris, on the banks of the Seine, a new waste-to-heat and power generation facility recently began operation. The facility collects the household waste of some one million inhabitants in the Paris metropolitan area and transforms it into heating for homes and electricity. No white steam plume or chimney stack betrays its presence. Tourists on pleasure boats that cruise the city's historic waterway would never guess that the elegant wood and metal facade houses a sorting and incineration plant 31 meters below ground. In this regard the plant is a miracle of form and function, blending unnoticed into one of the world's most beautiful cities.

The plant, known as "Isséane", was designed to be an exemplary model of integration into the urban environment. By any environmental quality criteria it is truly "green".

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The basic process

Waste materials entering the plant have already been sorted by community households into glass, plastic and metals, paper and non-recyclables in accordance with EU waste treatment regulations. A number of further steps are employed to complete the separation of recyclables, including mechanical sorting, magnetic separation, and visual sorting by operators and optical systems. With a recycling capacity of 22,000 tons per year, many loads of recyclables are returned from the plant each day to different industries for conversion to useful products.

The remaining non-recyclable waste stream accounts for 460,000 tons of combustible materials each year. This waste is converted into energy using a reliable and proven incineration process where temperatures reach 1,000°C. The waste becomes the fuel in a furnace in which hot combustion gasses and solid residue, called clinker, are produced. During the process all organic materials, pathogens and microbes are destroyed by the high combustion temperatures. The clinker is usefully recycled for surfacing roads, and the hot combustion gases become the starting point for energy production.

Conversion of heat to steam

The heart of the energy conversion process is a chamber similar to a boiler in a conventional fossil fuel power plant. Water at a pressure of 50 bar is passed through the chamber in a system of pipes. The hot combustion gas in the chamber heats the water in the pipes to 400°C. The pipes must withstand the effects of high pressure and temperature, and the corrosive effects of the gas. The pipes are, therefore, made of Alloy 625 (N06625, EN 2.4856), a nickel base alloy containing 25% chromium and 9% molybdenum. The unique combination of Ni, Cr and Mo gives it very good strength and excellent resistance both to stress corrosion during operation and to acid condensate corrosion that can occur during down periods.

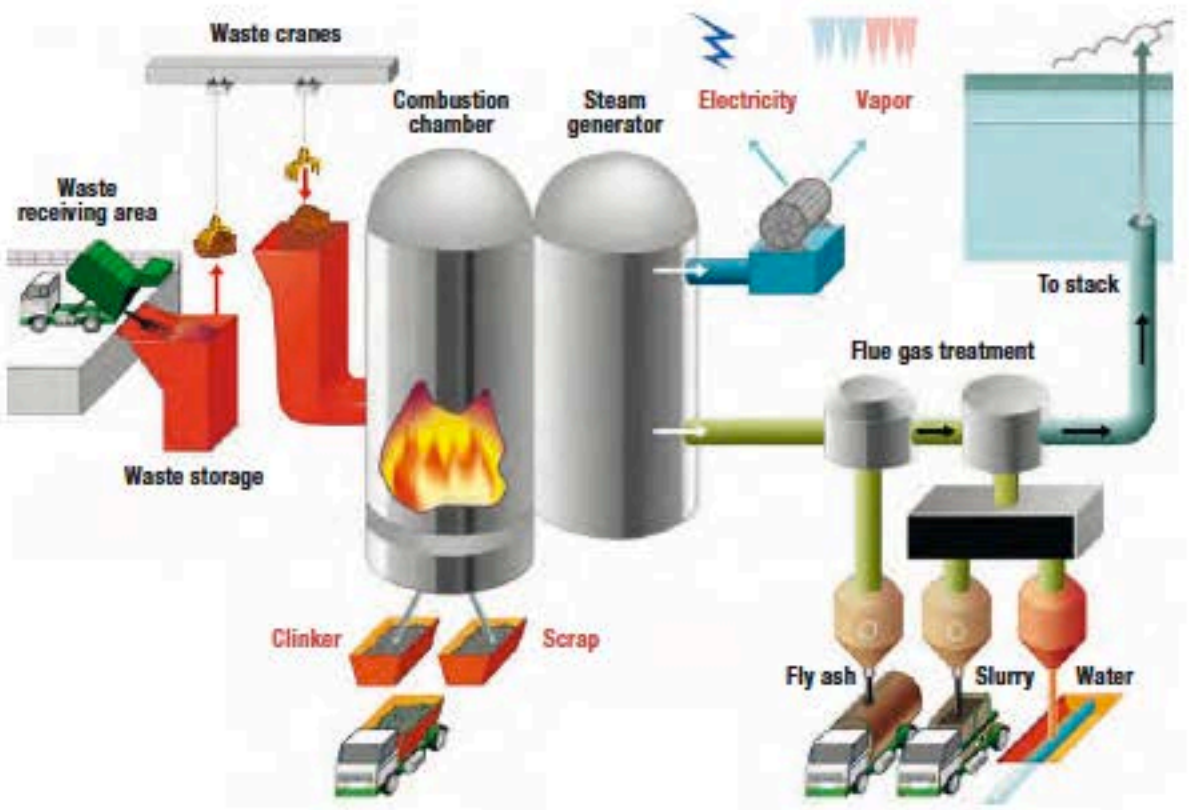
The energy contained within the high-temperature, high-pressure water is then converted into steam in a steam generator downstream from the chamber. The plant contains a dual furnace – dual steam generator system, having the capacity to produce 200 tons of steam per hour.

Steam utilized for electricity and heat

Steam exiting the steam generator at 400°C and 50 bar drives a steam turbine which in turn drives an electric generator. Molybdenum plays an important role in the turbine. Many parts are manufactured from molybdenum-containing alloys such as Alloy 625 and Type 316 stainless steel (S31600, EN 1.4401). Some important parts are the steam nozzles that direct the steam onto the turbine blades causing them to rotate. The good corrosion and wear properties of Type 316 stainless steel make it ideal for this application.

The steam turbine drives a 52 MW electric generator, providing sufficient electrical power for the facility's needs, and an excess which is sold to the national grid.

Exhaust steam at lower pressure and temperature is a valuable by-product, which is delivered to a local network supplying the heating requirement of 79,000 homes. →



Flow diagram of the plant showing how energy (waste) enters and leaves as useful electricity and heat, useful byproducts and clean flue gas. Credit: SYCTOM

Odorless and invisible releases

A very important final step of the process is the purification of the combustion gas before it exits the plant. This step decisively contributes to the high environmental quality of the Isséane plant. Purification of the flue gas begins with a scrubber which removes dust, acid gases and heavy metals by absorption in a neutralizing liquid media. Subsequently, the flue gas passes through a de-nitrification facility for the removal of nitrogen oxides (NO_x).

Nitrogen oxides are air pollutants that must be reduced to a minimum to limit their health impact. The de-nitrification facility employs the catalytic reduction of NO_x in contact with ammonia (NH_3). The end products are water and nitrogen, both normal and essential components of the air we breathe. Here again molybdenum plays an important role. The entire ammonia-water system is constructed of Type 316L (UNS S31603, EN 1.4404) stainless steel piping, chosen for its high resistance to acid corrosion. Using this process the NO_x emissions are reduced well below the threshold imposed by European regulations.

A winner for energy, environment and neighbors

A complete material and energy balance of the plant yields a startlingly favorable outcome for the environment and the impact on the surroundings. The transformation of waste to energy by the plant avoids the consumption of 110,000 tons of new fossil fuels (coal, etc.), and the associated emission of 330,000 tons of carbon dioxide (CO_2) into the atmosphere each year.

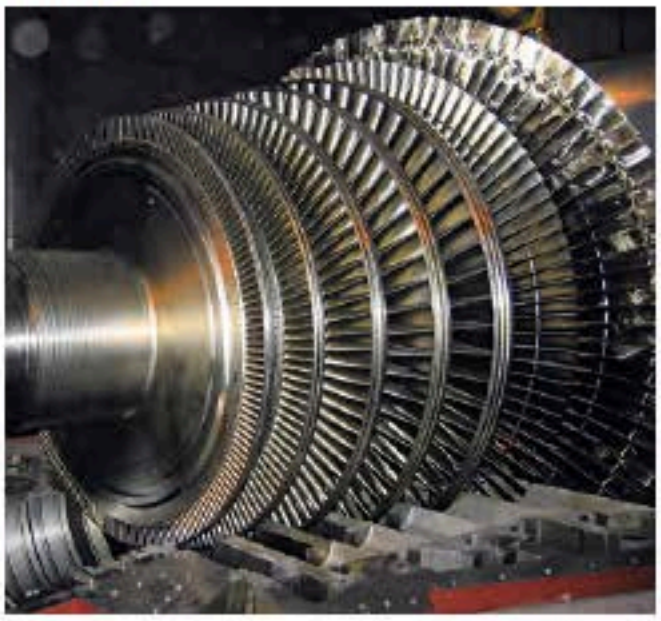
Given that more than 50 percent of the energy present in the non-recyclable waste comes from renewable materials such as plants and trees (regenerative energy), more than half the energy produced is CO_2 neutral. This further helps reduce greenhouse gases responsible for global warming.

Aerial view of the waste plant. Photo: SYCTOM

Compared to other thermal processing facilities, Isséane produces lower emission levels because of its high efficiency and advanced combustion gas cleaning technologies.

The pictures of the plant in this article show that it does not intrude on the urban landscape but coexists in an aesthetically pleasing way with its neighbors. Indeed, Isséane has served many competing interests well, so that all have emerged as winners. (tp)

One of two steam turbines used to produce electricity. Photo: SYCTOM



View of the waste plant façade facing the Seine. Photo: SYCTOM