Energy Efficiency in Process Heat Technologies

Process heating requirements are significant energy guzzlers in the industrial and service sectors. The BEE presents two case studies of research, development and commercialization of process heat technologies for drying and heating systems and for disposal of medical waste supported by TIFAC

Case Study 1

Microwave Drying and Heating Systems

One of the significant industrial applications of microwave is for drying residual moisture from products in food, chemical, pharmaceutical agro and rubber industries. Imported systems are plagued by high maintenance costs and lack of service support. An Indian company has made the first serious effort to develop microwave dryers for industrial applications. Technology Information, Forecasting and Assessment Council (TIFAC) supports commercialization of this technology.

Certain industrial sectors such as rubber industry (for vulcanization), bakeries (for drying biscuits), food industries, etc, have been acquiring imported microwave dryers to enhance product quality. Many of these industries have to face serious problems of maintaining the system over a larger period due to the lack of maintenance support. Microwave dryers are yet to be introduced in the chemical and pharmaceutical industries, despite enough scope for its application.

Hi-Tek Engineers, Mumbai, decided to indigenously develop the know-how of integrating conventional industrial dryers with microwave dryers. It has developed the design to manufacture conventional drying systems such as Fluid Bed and Flash Dryers. It has tied up with the society for Applied Microwave Electronic Engineering and Research (SAMEER), Mumbai, for the technology.

This project aims to develop an industrial drying unit in which the microwave system will be integrated with Fluid Bed Drying System in modular form, each having 5/1.5 kW generation capacity. Higher capacity systems can be built by cascading several such modules.

A typical microwave dryer consists of a high power microwave source with built-in control circuits and one or more applicators properly integrated with the microwave source. The microwave dryer is deployed in conjunction with the conventional dryer as one composite unit to obtain optimal drying efficiency. The applicators is the unit where the microwave energy and the material to be processed interact. As the material may be of different nature of for different applications, the applicator has to be customized for every industrial process. The power source comprises a high power magnetron and a circulator, which are currently not manufactured in the country. However, the total control circuit is indigenously developed for specific process control.

The activities for this technology up scaling project will include the development of microwave source, components and plumbing system, high-voltage power supply, control and interlock circuitry and fabrication of the microwave generator rack, integration of the microwave generator rack, integration of the microwave source with related circuitry, characterization and engineering evaluation of the microwave power generator along with development of applicators, and integration of applications with source.

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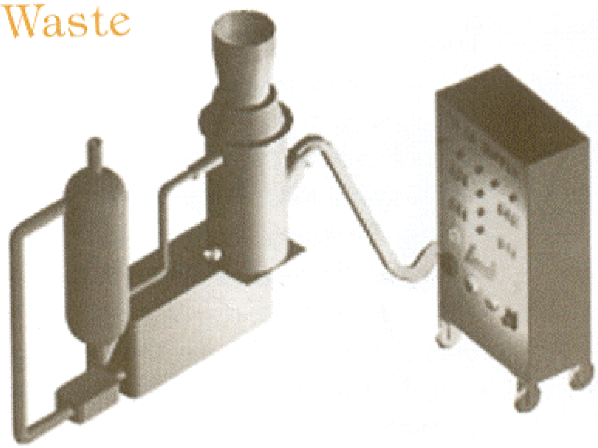
Case Study 2:

Plasma Pyrolysis Reactor for Safe Disposal of Medical Waste



Hospital waste such as dressing, blood bags, syringes, etc, are currently disposed off in the open. Burning pollutes, the environment, while there is a possibility of pathogens surviving if incineration is incomplete or done at low temperatures.

A Supreme Court directive has made it mandatory of hospitals with over 50 beds to install safe waste disposal systems. The Government of India has also issued a gazette notification, giving the dates for compliance,

The TIFAC and the Facilitation Centre for Industrial Plasma Technologies (FCIPT), a branch of Institute for Plasma Research, Gandhinagar, have collaborated to develop the Plasma Pyrolysis Reactor for disposal of medical waste.

The technology involves a plasma furnace, which provides a minimum temperature of 3,000 ^{o}C to ensure complete incineration and high fluxes of ultraviolet tradition to destroy pathogens completely, Gas flowing between two electrodes is ionized and ejected as plasma. The current passing through the plasma heats the gas to more than 10,000 ^{o}C.

The plasma torches can be run with small quantities of gas flow with a conversion efficiency of 80 per cent. The flame is directed at materials for pyrolysis and reaction is instantaneous. (Pyrolysis is the thermal decomposition or carbonaceous material without oxygen.) Typical gaseous products from organic wastes are rich in hydrogen and carbon monoxide. Inorganic wastes are reduced to a non-hazardous melt with a low unburnt organic residue less than 0.2 per cent of total organic carbon. It eliminates all harmful residues and the highly toxic sticky and grease ash left in conventional incinerating plants.

The temperature in the primary chamber is more than 7,000 ^{o}C and in the secondary more than 15,000 ^{o}C. The emissions are far better than the CPCB norms. Under optimised conditions, the system can provide large quantities of CO and H_2 gases as by-products. FCIPT is researching the use of product gas for direct fuelling of IC engines.

Trials have been conducted in simulated conditions and with actual hospital waste at the Gujarat Cancer Research Hospital Ahmedabad. TIFAC is now planning to put eight units of plasma incinerators at different hospitals across the country to demonstrate the efficacy of commercial operations. The technology is available for licensing to Indian industries.

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Public Health Impacts of Waste Incineration

Hundreds of incinerators – industrial kilns, boilers, and furnaces-annually burn an estimated 3 million tons of municipal solid and other hazardous wastes. Emissions from incinerators are regulated through the 1990 Clean Air Act. As part of the Act, the US Environmental Protection Agency (EPA) has defined Maximum Achievable Control Technology (MACT) standards, which require incinerators to attain emission controls that reflect the average of the best –performing operations. However, a national Research Council (NRC) report released in November 1999 notes that MACT standards may not be sufficient to protect incinerator workers and regional populations. According to the NRC report, the low reliability of measurd data and models, as well as imprecise data on intermedia transfer factors used to determine indirect exposure, are obstacles to regional-scale health assessments. Intermedia transfer refer to the exchange of pollutants between the air and soil, air and vegetation, and, air and water, soil and vegetation, and outdoor and indoor environments.

The NRC report comprehensively identifies three potential exposed populations: the local one, which inhales airborne emissions; workers, especially those who clean and maintain the pollution-control devices; and the larger regional population, who may be remote from any particular incinerator, but who consume food contaminated by one or more incinerators. Unfortunately, some of the MACT standards will not help people in all these categories. For example, workers who clean out air-pollution control equipment at municipal incineration plants have tested for elevated levels of dioxins and metals (arsenic, lead, cadmium, and aluminum) in both blood and urine, But, the new standards will only require fewer emissions from a plant and not change the work conditions for people in the facility.

Uncertainties Characterizing Impacts

To Characterize health impacts from incinerators, large amounts of data and models are required. But a lot of uncertainly is associated with these evaluation because the data and models must be used to characterize individual behaviours, engineered system performance, contaminant transport, human contact and uptake, and does and among large populations. The NRC report identified the issue of uncertainty and variability as having scientific and policy implications for attributing health impacts to incinerators. The committee noted that when the uncertainty and variability become large, interpreting or assigning relevance to the estimated magnitude of exposure and health risk become increasingly difficult.

One case in which uncertainty drives from exclusion is a health characterization based only on normal operating conditions. No data are available to evaluate actual emissions during start-up, which are normally higher than during routine operation. Consequently, probability of errors increases in evaluating exposure and potential health risks. If properly conducted, these assessments can be useful in the development of an effective risk management strategy.

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Reference Book:
The Bulleting on Energy Efficiency
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