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# Power Generation in The Chemical Industry

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***ABSTRACT:*** The chemical industry, particularly the production of organic and inorganic base chemicals, has a high demand for electrical and thermal power. In the chemical industry, power drives processes and profitability. With most of the chemical industries aiming to expand, having their own power generation plant is an emerging necessity. This paper provides a brief overview of the various ways in which the chemical industry has been generating power to meet the needs of its plants and, in some cases, selling the surplus power produced.

***KEY WORDS:*** power generation, chemical industry

## I. INTRODUCTION

Today, several nations are facing the serious issue of a power crisis, whereby the existing power generation capacity cannot meet the ever-increasing demand. Currently, power is produced in a centralized manner and distributed over long distances. However, analysts have predicted that centralized power production will be gradually replaced by distributed power generation, due to the loss of power inherent to long distance transmission, overall infrastructure cost, health and safety issues, and environmental problems [1]. Off-grid solar power generation for mobile and remote rural situations is a current example in which distributed power generation is readily taking hold.

The chemical industry is one of the fastest moving industries in the country. The importance of power for this sector is crucial. Figure 1 shows the percentage of energy used by the chemical industries [2]. In the petrochemical sector, for example, there is the need of a constant supply of power to keep refineries functioning continuously. The cost of power accounts for a large portion of the total cost of production. With most of the chemical industries aiming to expand, having their own power generation plant is becoming a necessity.

## II. POWER GENERATION

The various ways of generating power include:

- *Hydroelectric power:* This refers to the conversion of energy from flowing water into electricity. Power from falling water has been a vital part in the power supply in this country for some time. Hydroelectric power from Niagara Falls, for example, is cheaply produced and transported over distances in excess of 1000 miles [3]. Hydropower is an abundant, low cost source of power, in spite of high upfront construction costs. However, hydroelectric power plants are not free of greenhouse gas emissions. In creating the water reservoir to provide a steady and controllable source of water, plant life in the reclaimed area is submerged under water and rots, releasing the stored carbon dioxide. Plant matter settling to the bottom of the reservoir will decay under anaerobic conditions, increasing the methane content of the water. This methane is released when the water is used to turn the turbines of the hydroelectric plant. While hydroelectric power is generally considered emission free, this indirect release of carbon dioxide and methane can be significant.

- *Nuclear power:* This refers the energy held in the nucleus of an atom. It can be obtained through fission or fusion. Chemists and chemical engineers play a significant role in the design and operation of nuclear powered electric generating stations. Electricity generation from nuclear fission is very attractive due to the challenge posed by global warming and concerns about the future availability of petroleum and natural gas. A major challenge of nuclear reactor operation is the high level of radioactive waste created and the associated disposal problem. This problem has stopped all construction of nuclear plants in the United States [4].

- *Thermal power:* This involves converting heat energy to electric power. Almost all coal, petroleum, nuclear, solar thermal electric and waste incineration plants, as well as many natural gas power stations are thermal. Most thermal stations use fossil fuels (coal, gas, oil) as the main fuel [5]. In certain chemical processes, it is possible to integrate a gas or steam turbine with the associated electricity being used to power your site. Through increased overall efficiency, this will reduce the environmental impact of the plant.

- *Renewable Energy:* Renewable energy sources, such as sun and wind, have become increasingly prevalent and have helped drive progress towards the decarbonization of electricity. The utilization of wind and solar energy is highly dependent on local weather conditions and is therefore a potentially volatile supply of electricity. Production of pyrolysis bio-oil can enhance the supply of fuel in small scale systems to produce power. The electricity produced from burning pyrolysis oil and biochar is competitive with the fuel oil and coal electricity markets [6].

- *Energy from waste:* It is feasible to generate energy from waste and build a modular system for use in very specific applications. Waste-to-energy uses waste or garbage as a combustion material for generating power, just as other power plants use coal, oil, or natural gas. The waste materials are converted into usable heat, electricity, or fuel through a variety of processes such as combustion, gasification, and landfill gas recovery.

The chemical industry has been increasingly using elements of cogeneration (combined heat and power) or dedicated generation to meet the needs of power in its plants and in some cases selling the surplus power produced. In India, for example, the chemical industry has its own generator which is connected to the power grid and the industry also contributes its power to the grid [7].

Traditionally, huge amounts of electricity can be stored by pumped-storage hydropower stations. Currently, long-term storage can be realized by chemical compounds, such as hydrogen and methane or liquid hydrocarbons. This requires a conversion of electricity into a chemical product via water electrolysis and a reconversion into electricity. The main problem with this storage process is low efficiency [8].

Currently, the idea of smart grid technology is popular. A smart grid makes possible two-way communication between power producers and the customer. The main objective of the smart grid is to bring reliability, flexibility, efficiency, and robustness to the power system [9] in a fashion that supply and demand are continuously managed for optimum efficiency.

## III. CHALLENGES

The need to control pollutants from power plants while at the same time utilizing waste products to generate income is a challenge. Decarbonizing the chemical industry would have a significant impact on global carbon dioxide emissions, and electrification of the industry. This can be achieved either by avoiding the generation of carbon dioxide altogether or by converting otherwise emitted carbon dioxide into valuable commodity chemicals [10].

The higher evaporating temperature results in more work converted by organic substance vapor and more power output, while the lower condensing temperature results in higher power generation efficiency. How to utilize low-temperature waste heat effectively is another challenge [11].

## IV. CONCLUSION

The role of the chemical industry in power supply is ever increasing. To combat the emerging energy crisis and overcome the constraints of alternative renewable energy sources like solar and wind, new methods of generating power have been proposed [12]. Electrification of the chemical industry will help match the trends in modular and local manufacturing.

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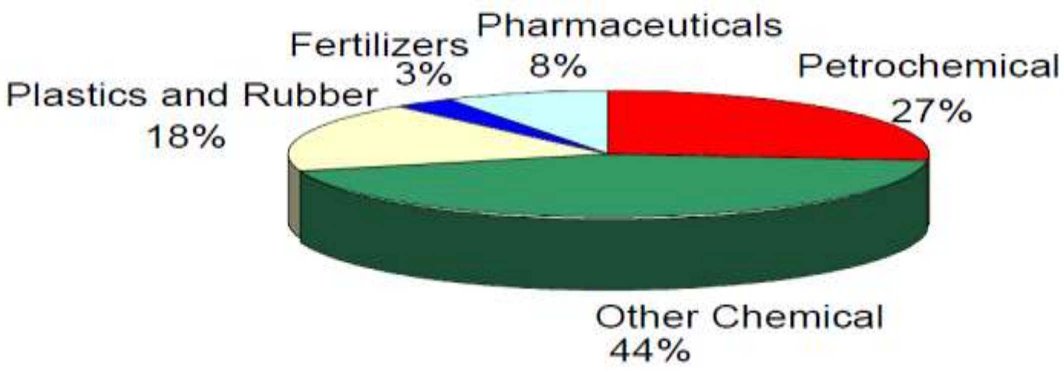


Figure 1. Energy usage by the chemical industry [2].