The phosphate mineral is one of the important key vectors for the Tunisian economy balance. This mineral is used to produce several chemical products and fertilizers. Globally, the Tunisian phosphate industry occupies the 5th place in the world among the largest international operators in these activities.

Several Chemical Industrial Factories are implanted in different region of the country. That constitutes an important factor for the national economic balance and employment rate.

Despite the economic importance of the phosphate industry, it is considered among the largest energy consumers. In fact, the total annual cost of the energy production is very substantial.

To overcome this problem, the Tunisian Chemical Group (TCG) established programs in the purpose to improve the quality of production and increase the performance of the different plants.

In the frame of this program an optimization study on a thermal power plant used in a phosphoric acid factory is conducted. The obtained results will be presented as follows.

### Operating mode of the analyzed power plant

### Results and Discussions

The generated power increases gradually with HP steam mass flow rate. For HP steam mass flow rate above 40 t/h, the condenser rate leads to the enhancement of the generated power. A maximum net power of about 6 MW is obtained for a condenser rate of 20 t/h.

The total power generated by the two steam turbines is widely sufficient for the plant requirements.

The energy efficiency increases with HP mass flow rate to reach maximum values as follows: 50% for condensation flow rates of 38 t/h 53% for condensation flow rates of 52 t/h 56% for condensation flow rates of 58 t/h.

The optimum mass flow rate leading to the indicated maximum energy efficiencies are: 55, 56, 52 and 54 t/h.

### Conclusion

The energy and exergy efficiencies increase linearly with the pressure of steam. For the explored ranges of pressure, the energy efficiencies increase of about 0.37% and 0.8% for STGII and STGII respectively.

The energy efficiencies increase of about 2.9% for STGII and 4.8% for STGII.

The two seawater coolers of Turbo Blower CBT and Steam turbine TC are considered among the main components of the power plant. Their irreversible rates are affected by the seawater temperature.

The seawater temperature from 12 to 24°C leads to an increase of the efficiency of about 6 times for the turbo blower condenser CBT and 4 times for the turbine condenser TC.

For L seawater above 25°C the energy efficiencies increase slightly to reach maximum values of about 35% and 45% for the turbine condenser and the turbo blower condenser respectively.

The effects of the key operating parameters on the power plant performances are investigated (mass flow rate, HP pressure and temperature, seawater temperature...)

The Steam Turbine Generator STGII presents energy and exergy efficiencies of about 75% and 47% respectively, while the STGII presents energy and exergy efficiencies of about 96% and 76% respectively.

The energy and exergy efficiencies of STGII and STGII increase slightly according to HP steam pressure.

The optimum steam mass flow rates leading to the maximum net power and energy efficiency are: About 55 t/h for STGII, About 58 t/h for STGII, About 73 t/h for STGII.

The seawater temperature affects significantly the exergy efficiency of the condenser. That should by taking into consideration for the operating conditions in cold seasons.

The obtained results constitute helpful tools to analyze the real performances of the existing power plants and permit to better understand the future modifications that can be carried out on the different streams in order to improve the efficiency and reduce the energetic losses.

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