Using parabolic trough for phosphating process

SKF Technologies, Mysore

pwc

SKF Technologies Pvt Ltd is a wholly owned subsidiary of SKF AB in India. The Swedish parent company has been one of the leading global technology providers since 1907. Over the years, it has invested in India to expand SKF's platform products portfolio and owns two fully functional manufacturing plants for sealing solutions in Mysore. One of the plants serves diverse sectors and markets across the country with a variety of standard as well as customised sealing solutions for automotive and industrial applications. This factory was commissioned in October 2012 and serves customers within the automotive, railway and industrial applications segments.

Technology

At SKF Mysore, a parabolic trough based solar concentrating system has been installed for process heat application. The system contains 40 parabolic trough based collectors, SolPac P60s, each of 6.41 m^2 aperture area connected in a series-parallel combination to generate pressurised hot water at130°C. The total trough collector area is 256.4 m^2 and the system has been installed on the terrace of the establishment. This assembly of collectors supplies hot water in conjunction with a back-up generator (diesel fired). SolPac P60, the solar parabolic trough from Thermax, consists of a reflector, a glass covered receiver tube placed at the focus of the reflector, an automatic tracking system and a support structure. The sun's rays concentrated on the receiver tube heats the working fluid (water in this case) flowing through the tube. The maximum temperature that can be attained using this technology is 210°C.

Each single module of a SolPac P60 (6.41m^2) needs a shade free area of 10m^2 and weighs 250kg. It has an output capacity of 1.4 to 1.8kW_{th}. Thus, the total shadow free area requirement for 40 modules is around 400m^2 and weighs 10 tonnes.

SolPac™ P60 Parameters(Single Parabolic Trough)	
Heat delivery	11000 Kcal/day
Total aperture area	6.41 m^2
Total shade free area	10 m^2
Total weight	250 kgs
Tracking	Single axis automatic

System Details	
No of troughs	40
Total aperture area	6.41*40 = 256.4 m^2
Total shade free area	40*10 = 400 m^2
Total weight	250 kgs*40 = 10 tonnes
Name of manufacturer	Thermax Ltd

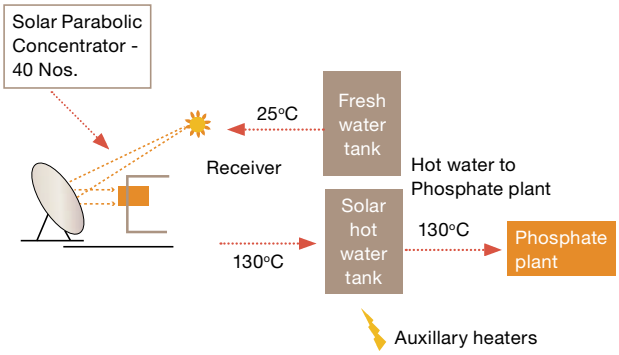
Application

A total of 40 parabolic troughs have been installed at the site. The principle application of Solpac at SKF is to heat the water for circulation through the treatment tanks in the phosphating plant where the desired temperature is about 95°C. The overall objective of this process is to:

- coat phosphate on the metal stampings which helps in bonding reused vulcanised rubber and
- reduce the probability of rust formation.

The phosphating plant involves a 11 tank process and has five major stages. The first stage is where the oil and grease are removed from the stampings. In the second stage, another round of cleaning takes place to completely remove the chemical and grease from the stampings. The third stage involves coating a phosphate layer on the stamping. The fourth stage comprises the rinsing process in which all the dirt or impurities are removed from them. The final stage involves drying in the conventional dryers from where the stampings are sent for further processing. The hot water requirement is mainly in the first, second and third stages of the process. The system generates pressurised hot water at 130°C which is then passed through the coils in the tanks of the phosphating process to deliver heat at 95°C. For days when the incident solar radiation is not strong enough, the system has also been integrated with a diesel fuelled back-up generator.

Layout of the plant



Why solar technology

SKF Technologies believes that everything one does has an impact on the environment. The impact varies from the amount of energy utilised to manufacture products to the amount of energy used by customers for these products and the manner in which these products are disposed off. Each of these steps offer a possibility for reducing this impact and by doing so, not only can one ensure a greener environment for future generations but also create a sustainable competitive advantage.

In spite of this plant being commissioned very recently, the management decided to go for solar concentrator based systems for their process requirements. Ever-increasing fuel costs also adversely affect the company's profitability considering the fuel market is so volatile. The company would have been otherwise spending around 8.5 lakh INR annually on fuel for a plant of this size. Solar energy, on

the other hand, involves minimum operational costs after a one-time capital investment. The management is also mindful of the fact that using conventional fossil fuel based systems results in huge GHG emissions. All these factors contributed towards SKF taking the decision to install the trough collectors for their process energy requirements.

Fuel saving and project economics

For any industry, it is important that the project economics are within the acceptable range for implementation. To support such industries and to promote solar energy, the Ministry of New and Renewable Energy (MNRE) provides a subsidy for concentrated solar technologies based installations based on the benchmark cost or 30% of the project cost, whichever is lower.

The parabolic trough collector based system at SKF has been installed by Thermax Ltd. The total project cost of this system is 70,55,000 INR. This cost also includes the balance of the system cost such as piping, civils, etc. The balance of the system costs varies and is specific to every installation. Since this is a single axis tracked system, the subsidy from the MNRE, based on the benchmark cost is 5400 INR per sqmtr. The total subsidy applicable for the trough based system, as per the MNRE benchmark for 256.4 m^2 is 13,84,560 INR . Thus, the overall project cost without the subsidy available from the MNRE is 56,70,440 INR. The financial analysis ensures that an additional accelerated depreciation benefit of 80% of the project cost is also available for the unit owner. This accelerated depreciation is available under the IT Act and can be availed on 80% of the total cost incurred on solar concentrators. This benefit can be availed to reduce the tax outflow during the first year. The following assumptions have been made to determine the financial feasibility of the project site:

Cost of fuel replaced (diesel)	60 INR/litre (bulk purchase cost)
Annual escalation in fuel price	5%
Debt: equity for beneficiary's contribution	70 : 30
Cost of equity	16 %
O&M as a % of project cost	1%
Inflation in O&M	1%
Deration	1%
Days of operation	275

Following are the results of the financial feasibility analysis based on the above assumptions:

WACC	13.41%
Project IRR	18.02%
Equity IRR	30.35%
Payback	5.2 years
Fuel savings(litres of diesel)	approximately 14000 per annum

Thus, the project results in a payback of 5.2 years and SKF will recover the entire investment made with the savings on the diesel cost alone. The company reduces their diesel consumption by over 14,000 litres annually which directly translates to around 8,40,000 INR. In addition to this, they will also contribute towards saving the environment by eliminating GHG emissions. Post the recovery of the investment, SKF shall run the plant at minimal operational costs for 25 years. Thus, it is advisable for the other industries as well, to opt for CST based systems for their process needs.

Beneficiary's perception

Though the system has been operating for only a few months, as per the beneficiary's experience, the output temperature has generally been above 135°C.

The consumer speaks

"The solar parabolic trough system has been effectively working as per our needs and has been instrumental in helping us save on costly conventional fuel."

- Plant Maintenance Manager, SKF Technologies

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