

Interests in Trigeration

Use of combined heat, cooling and power for small enterprises

The total installed captive power capacity of gensets up to 1,000 kVA is estimated to be at least 10,000 MW, according to the Captive Report, 2005 by Power Line Research. These captive power users include enterprises like restaurants, warehouses, clubs, super-markets and shopping centres, BPO centres, airports and hospitals. They use gensets of small capacity – from 400 kVA to 1,000 kVA – and have heating as well as cooling requirements. Installation of trigeneration systems could be highly useful for such enterprises as they not only provide electricity but also meet heating/cooling needs.

Trigeration is an emerging concept, which takes the conventional combined heat and power (CHP) solution a step ahead. It involves simultaneous production of cooling, heating and power – all in one process.

A gas-based trigeneration system can be up to 50 per cent more efficient than the combined cycle CHP one. It produces four different forms of energy from primary energy: hot water, steam, chilled water and power. Such a system is essentially a CHP unit with added absorption chillers, which convert waste heat from the CHP unit into useful energy in the form of chilled water.

While heat recovery is gaining ground in large process-driven industries, small enterprises running on liquid fuel gensets still do not have a solution. All major engine generator companies the world over are developing compatible systems for using waste heat from smaller reciprocating engine-based generators their efforts are directed towards manufacturing gensets, which can be easily connected to the heat-fired chillers at a price competitive with conventional chillers. Fully packaged gensets are also being developed. Rapid payback is a key consideration in all such developmental works. Economical operation in continuous mode is also important.

According to a study, a 1,000 kVA genset operating at 80 percent load can produce 500-600 kg of steam per hour. It can churn out heat thermic fluid or pressurized hot water up to 250,000 kcal per hour and provide cooling up to 100 tonnes. Similarly, jacket water heat from a 1,000 kVA generator can provide significant refrigeration by feeding the low grade jacket water heat through the vapour absorption refrigeration system.

Absorption chillers have recently gained widespread acceptance not only due to their ease of integration with the CHP systems but also because they can operate with industrial waste heat streams. Low quality heat (that is, low temperature, low pressure) exhausted from power generation plants is capable of driving absorption chillers, which can replace the conventional vapour-compression chillers that are driven by electricity. This can significantly reduce the overall primary energy consumption.

The decision of using a combined heat, cooling and power system or trigeneration should be made at the time of selecting the genset to obtain optimal sizing of the primary heating equipment. The process heat application must be determined before selecting the heat recovery option. The maximum usage hour load and not peak load should also be determined. The design must be based on usable heat recovery and not available heat. The location of genset should be close to the discharge point of recovered heat. Ease of maintenance and space considerations must also be taken into account. Where boilers are not a primary requirement of the process, the design should provide better alternatives.

Installing a trigeneration system close to where there is requirement for electrical and thermal energy can be up to 90 per cent energy efficient. The resultant steam and chiller credits reduce the cost of power consumed. Trigeration is also environment-friendly.

While trigeneration for small enterprises is catching up in the US, both because of the need for efficient energy systems and the government's emphasis on increasing the share of CHP solutions in the total electricity generation, the engine generators are primarily gas based. In India, trigeneration has not yet gained commercial significance although awareness is increasing and the subject is being discussed at various industry forums.

Reference Book:

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