Solar Energy Potential in Industries

There is a vast potential for use of solar energy devices / systems in industries for process heat and other thermal applications. Presently, energy for these applications is being met mainly through fuel oil which is not only import dependent but is also creating huge GHG emissions in atmosphere resulting threat to our planet. India is consuming over 100 million tones of oil every year for various uses. Out of this, almost 40% is being consumed in the industrial sector alone. Further, 40-50% of this consumption is in thermal form alone with temperature range below 250 C which comes to around 15 million tones of fuel oil per annum. The applications include mercerizing, drying and finishing in textile industry; drying, dissolving, thickening, leaching and distillation in chemical industry; cooking, drying and canning in food industry, craft pulping, bleaching and drying in pulp and paper industry, drying and cleaning in leather industry and various such applications in many more industries. The working fluid required for these applications is either pressurized hot water, steam or hot air in temperature range of 60-250 C.

There are number of solar energy technologies which can be used for such applications and reduce consumption of fuel oil mainly during day time. The technologies include solar water heating systems, steam generating systems and air heating systems based on flat plate or evacuated tube collectors and automatically tracked solar concentrating collectors.

Solar water heating is a well established technology and is in promotion world wide. It can be used in industries for boiler feed applications in raising water temperature from 25 to 80 C and thereby saving a substantial amount of fuel oil being used in boilers. A 10,000 liters per day capacity system may cost between Rs. 15-18 lakhs and can save around 14,000 liters of fuel oil per year for a period of about 20 years, the life of the system. The largest system installed is of 1,20,000 liters per day capacity at M/s Godavari Fertilizers and Chemicals Ltd., Kakinada, Andhra Pradesh. The system was installed in 1997 through soft loan from IREDA and it recovered its cost in four years. Another system installed at textile factory in

Gurgaon with a capacity of 50,000 litters per day has been working since October, 2007 and has recovered the cost in two years. Many more such systems have been installed in various industries and are functioning satisfactorily.

Solar air heating systems based on flat plate collectors have been found to be useful in food processing industries for drying of various food products. These industries generally require hot air at low temperature (50-80^{0}C) as process heat for drying of products such as tea leaves/ coffee beans, and also for processing of fruits, spices, cereals, mushroom, papad, vegetables, fish, seafood etc. Hot air is also required in industries such as leather, textiles, chemicals, rubber, paper, pharmaceuticals etc. It is estimated that over 800 million kg. of tea leaves are being produced and dried in Southern states, Himachal Pradesh, West Bengal, Assam and North East States. Another 250 million kg. of coffee beans are also being produced and dried every year. Millions of tones of food and industrial products are also being dried annually in various industries in the country. The systems installed in industries for drying of various products have been saving a significant amount of fossil fuel, apart from improving the quality of end product and reducing GHG emissions. A typical system of 100 sq. m. of flat plate collector area may cost around Rs. 5-6 lakh which could save up to 6000 liters of conventional fuel for a period of over 15-20 years. Over 60 such systems of different capacities comprising of 12,000 sq. m of collector area are functioning in the country.

A solar air heating system with 90 sq. m. collector area has been installed at M/s Raghav Woollen Mills, Ludhiana, Punjab for drying of garments in their tumbler dryers. It has replaced the cool ambient air of about 30°C with solar pre heated air of 55 – 65°C which is further raised by diesel fired hot air generator to 100 – 110 °C for drying the garments. With the result, they have been saving 25% of their fuel consumption amounting to around 1.50 lacs per annum. The payback period has been reported to be two years and system is expected to last more than 15 years.

A roof integrated solar air heating systems with 700 sq.m. of collector area has been installed in a leading ternary at Ranipet, Tamil Nadu for drying of leather.

The factory uses two imported dryers where moving leather is being dried by hot air of temperature around 70 C. produced by heat exchange from steam coils. Hot air produced from solar collectors have reduced the usage of steam in heat exchanger during the day time. The system was able to save around 360 tonnes of fire wood used in the boiler apart from replacing a 1.2 tonne capacity steam boiler.

A 500 kg. capacity solar fish drying unit is functioning at Vishakhapatnam, Andhra Pradesh since 1999. The system generates hot air from 60 sq. m. of roof integrated solar collectors which is sent to the recirculation drier being run on electricity. It has resulted in huge saving of electricity besides obtaining good quality of dry fish. Many more such systems for other applications are functioning in the country.

The other technology which is very promising and is being widely accepted by the industries is solar concentrated technology. It can provide steam up to a temperature of say 300 C which is the direct need of industries. In India, two types of such technologies are in promotion for this purpose. Systems based on these technologies are being locally manufactured and are being promoted by 8-10 manufacturers. One of the technology is based on fixed receiver East-West automatically tracked parabolic concentrators and the other is on fully tracked heat receiver and dish reflectors. While the first one is more user friendly and can provide low temperature steam at a temperature of say 120 to 200 C, the other one is little complex and could provide steam at higher temperature ranging to 300C. Systems based on fixed receiver technology have been under installation for last many years and over 70 systems covering around 25,000 sq. m of dish area have been installed so far in the country. Fully tracked technology is under pilot scale demonstration and only 10 dishes, each of 160 sq. m. area have been in use till date. Both these technologies are mainly being used for community cooking, laundry and process heat applications. The World's largest system for cooking in community kitchen has been installed at Shirdi to cook food for 20,000 people which is producing around 4000 kg of steam per day and is able to save around 60,000 kg of LPG every year.

A system comprising of 15 dishes, each of 16 sq. m. area has been installed at Gajaraj Cleaners industry, Ahmed Nagar, Maharashtra for washing & cleaning of clothes. The system has been hooked up with their existing boiler and is generating about 105 kg of steam per hour at 5 kg pressure. It has been reported to be saving around 10,000 liter of furnace oil per year and paid back the cost in less than 4 years after availing subsidy from MNRE and depreciation benefits.

Tapi food industries, Gujarat installed a system of 100 sq. m dish area at their food & fruit processing unit in 2006. This system is also hooked up with their wood fired boiler and has been generating 400 kg of steam/ day at 6 bar pressure. The savings have been reported through firewood and labour cost which comes to around Rs. 2.45 lakhs/ year. It has also paid back the cost in 3 yrs with depreciation benefit and MNRE subsidy. Many more such systems are functioning in the country for various applications.

Recently, concentrating solar technologies have found applications for air conditioning also. Vapour absorption machines are widely in use in the country for cooling that require heat in the form of steam or pressurized hot water. The steam/ hot water is generally being generated using conventional fuel which can partially be saved by installing steam generating systems based on solar concentrators. A few such systems are operational in the country which include 100 TR air conditioning plant at Muni Seva Ashram, Vadodara; 92 TR at TVS, Suzuki factory near Chennai and 30 TR plant at Magnetic Mareli, Gurgaon etc. Another system of 212 TR capacity (160 TR on vapour absorption technology and 52 TR on liquid desiccant cooling) is under installation at Chattrapati Shivaji Maharaj Hospital, Kalwa governed by Thane Municipal Corporation, Maharashtra (TMC).

Solar cooling has a vast potential in the country. It is, however, an energy intensive process. But it is also true that cooling demands are maximum mainly during day time when solar energy is also prevalent, and this is more so in the hot summer season. India has abundant sunshine in major parts of the year. Solar cooling / refrigeration is, therefore, most relevant for our country especially in view of

the rapidly increasing demand for energy and shortage of electric power. The cost of these systems are, however, presently high and thus efforts are being made to bring down the cost through R&D mainly by i) improving the performance of existing technologies ii) developing triple effect vapor absorption machines with high co-efficient of performance (CoP) and iii) developing newer models of cost effective technologies on solar cooling.

Efforts are also being made to develop newer technologies which includes Parabolic trough concentrators with single axis tracking arrangement and Paraboloid dishes with two axis tracking. These technologies have already been demonstrated successfully in abroad especially for the purpose of power generation.

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