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IMPLEMENTATION OF SOLAR INDUSTRIAL PROCESS HEAT: SUMMARY

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SUMMARY

Process heat is used in such a diversity of industrial applications that it is misleading to categorize solar industrial process heat (SIPH) as a homogeneous entity. Various studies have been carried out in an attempt to identify the solar potential as a function of standard industrial classifications (SIC codes), quantified by energy use and maximum process temperature in each classification. However, it is becoming increasingly obvious that considerable detail is required for any given industrial use to accurately determine SIPH requirements.

For example, recent studies [1] at SERI have examined the potential for SIPH in such diverse applications as petroleum refining and fluid milk processing. Petroleum refining involves many different operations, and each of these can entail subprocesses over a wide range of process fluids and temperature levels. A careful examination of process needs shows that about 22% of refinery process heat is delivered below 290°C (550°F), and almost 63% is delivered between 290°C (550°F) and 590°C (1100°F). While the higher temperature processes usually require fossil fuel combustion, the lower temperature needs could be supplied by solar energy. By contrast, fluid milk processes in dairies are entirely low temperature, generally requiring hot water or steam for cleanup at 60°C (140°F) and for pasteurization at about 77°C (170°F). An evaluation of this application was carried out taking into account different combinations of collector technologies and system configurations over the U.S., identifying promising near-term SIPH possibilities. This kind of detailed systems analysis appears to be necessary to obtain a valid assessment of the economics of SIPH, since regional influences and system-dependent solar costs markedly affect results. It may be possible both to treat systems in the necessary detail and to cover a wide range of industrial needs by approaching the problem from the viewpoint of generic system processes (e.g., hot water heating, 125 psi steam production). In this way, a limited number of SIPH configurations could find broad industrial applicability.

The systems engineering for SIPH applications must improve beyond the present state-of-the-art to be acceptable to industry. In addition to the obvious needs for system durability and reliability, good engineering practice must be carefully implemented. In many cases, energy conservation techniques in industry can be more cost effective than adding solar energy systems, and thus a credible solar application evaluation must first fully explore conservation improvements. Other process considerations can be equally important [2]. Often high temperature sources are used to provide low temperature process heat. As an example, package boilers are often used to supply process steam for

hot water heating. There is evidence, however, that energy conservation practices are causing a shift to direct hot water heating, which is more readily accommodated by solar technology.

A number of SIPH engineering field tests sponsored by the Department of Energy are underway in phases ranging from conceptual design to operation. These projects illustrate some of the engineering practices discussed above. Most, however, are retrofit applications and do not utilize the full potential of a solar energy system. Moreover, the limited operation to date (three hot water and four hot air systems below 200°F) has shown lower than predicted system efficiencies. In addition, component or system failures and inadequate system design have resulted in unacceptably low solar system utilization [3].

In conclusion, the implementation of solar industrial process heat systems will depend not only on the successful development of reliable and efficient solar technologies, but also on the intelligent and sound application of process engineering principles. This poses an important challenge which must be given increasing attention if SIPH systems are to be adopted by industry.

References

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