WASTE HEAT

UTILIZATION AND MANAGEMENT

SUBRATA SENGUPTA
SAMUEL S. LEE

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Edited by

Subrata Sengupta
Samuel S. Lee

Department of Mechanical Engineering,
University of Miami

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Preface

Waste heat, which has been of some concern for its environmental impact, is today a valuable resource. On an average, for every unit of chemical energy converted to electricity or mechanical effort, two units are rejected to the environment. The potential for recovery is phenomenal, but widespread commercial acceptance still requires research and development effort. The wide variety of intellectual disciplines involved in waste heat research and the variety of commercial and governmental groups involved in supporting such efforts makes periodic interdisciplinary review essential, to reduce duplication of effort and to enhance interaction.

The first conference on waste heat management and utilization held in Miami, Florida, May 9-12, 1977, was well attended, and the proceedings were published in three volumes.* In response to continued interest, the second comprehensive conference on the subject was held December 4-6, 1978. This established a biennial frequency and allowed significant progress during meetings. The third conference, held during May 11-13, 1981, further helped in meeting the needs of the waste heat community. This volume constitutes the proceedings of the third conference. The topics, as with past conferences, cover the diverse energy and environmental issues relevant to waste heat.

The conference had working sessions covering important topics in subject areas, such as ecological effects, modelling, and utilization. Each working session featured an invited lecturer to set the tone for the session, and the session reports are included in these proceedings. A wide variety of sessions cover areas as diverse as mathematical modelling of dispersion and legal aspects. Topics ranging from ecology to heat rejection equipment have been given comprehensive treatment. These proceedings thus serve as the state-of-the-art document on waste heat research and development and as a reference book for the waste heat community.

This volume will be of interest to waste heat researchers concerned with resource recovery and mitigating environmental effects. The volume will also serve the legal, technical, and management experts associated with environmental impact of waste heat. Several papers deal with the hardware of advanced heat rejection system.

The support of the United States Department of Energy, the Environmental Protection Agency, Electric Power Research Institute, the Nuclear Regulatory Commission, and Florida Power and Light Company ensured that all points of view were presented. The representatives of these organizations are responsible to a great extent for the usefulness of this document.

Subrata Sengupta and Samuel S. Lee

*Lee, S. S., and Sengupta, S. (eds.), *Waste Heat Management and Utilization,* vols. 1-3, Hemisphere, Washington, 1979.

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The conference committee is grateful to the keynote speaker, Mr. Floyd Culler, and the banquet speaker, Mr. Leonard Weiss.

The advisory committee played a significant role in shaping the contents of this conference. The efforts of the session chairmen and co-chairmen are gratefully acknowledged.

The sponsoring organizations and the scientists and managers, who have provided leadership in sustaining continued growth in the important field of waste heat research, have our sincerest gratitude.

The authors and other participants have played the most important role in defining the present status and future directions.

The Conference Committee

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OVERVIEW

An Overview of the Department of Energy Waste Heat Recovery Program

JOHN W. NEAL
Office of Coal Utilization
Department of Energy
Washington, D.C., USA

ABSTRACT

Proper utilization of scarce energy resources is one of the goals of the Department of Energy (DOE). At present about 85 Quadrillion BTU's (Quad) of energy is consumed in the United States every year. Out of this, 15-20 Quads/year constitute "avoidable loss" in conversion process and another 15-20 Quads/year may be termed "avoidable waste," which could be saved. Therefore, potential energy savings could amount to 30-40 Quads/year. Converting this to equivalent barrels of oil per day, a savings of about half this amount (15 Quads) would more than offset our current daily oil import levels of 6.5 to 7.0 million barrels.

The waste heat recovery programs of DOE were triggered by the energy crisis. To date, feasibility studies, market studies, and development and demonstration programs have been funded by DOE to identify, investigate and utilize energy recovery potentials. Some of the major sources of waste heat are powerplants, gaseous diffusion plants, industrial processes, chemical plants, petroleum refineries, boiler exhausts, diesel engine and gas turbine exhausts, furnace exhausts, etc. The temperature range of these waste heat sources can vary from 100-1500^{o}F, and the source medium may be in the form of gas, liquid, or condensing vapor. The quantity of available heat also varies from source to source.

Based on the above factors, several options of heat recovery can be considered. First, is the direct heat utilization by using heat exchangers, recuperators and distribution system. This is feasible when applications are appropriate for the temperature level of the source. The second option is the utilization of a heat pump to boost the temperature of the waste heat to a useful level in order for it to be used in applications that can generate steam or high-temperature liquids. With this approach a greater number of industrial applications can be satisfied. The third option is to generate shaft/electric power using organic (or steam) Rankine cycle engines. This has the advantage of feeding power to the utility and grid if application is not found in the immediate vicinity of the waste heat. Other options include thermal cooling, desiccant dehumidification and so on.

Present Government programs include development and demonstration of the above mentioned system options and to identify market potential of each system. Some notable programs include Residual Energy Applications Program (REAP), which involves gaseous diffusion plants and similar low- and high-temperature sources and the Conservation and Solar Applications Industrial