



**CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY
(Former Mines Branch)**

SUMMARY OF "ENERGY TECHNOLOGY" SESSIONS
AT 104TH AIME ANNUAL MEETING, NEW YORK,
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Introduction

"Energy Technology" was the special theme of the 104th AIME Annual Meeting in New York on 16-20 Feb. 1975. Because of the effort under way within CANMET to coordinate R&D within this area, a concise summary of the energy-related content of the conference may be of some interest and is the subject of this report.

Sessions were organized into four groups: AIME-All-Institute, Society of Mining Engineers (SME), The Metallurgical Society (TMS), and the new Iron and Steel Society (ISS). Each group of sessions contained "energy technology" features particularly related to the specialty.

The general format of this report will consist of a brief description of the energy-related papers within each group, with particular attention to the TMS sessions. Two series of sessions, on "Energy: Use and Conservation in the Metals Industry" and "Materials in Energy Use", are of particular interest to PMRL and will be reported in more detail. For more information (abstracts, author affiliation, etc.), a conference program is available from the author of this report. Comments in this report on the sessions should be regarded as the considered opinion of the author, and should not be read as an agreed consensus.

The conference dealt mostly with U.S. concerns, of course, but the need for monitoring of energy technology at an international level will be considered as accepted for the purposes of this report.

Session Summaries

(i) AIME-All-Institute

Opening overview session: four general papers on supply/demand for oil and gas, synthetic fuels, coal, and nuclear power.

Special session emphasizing involvement of AIME societies in energy technology: five statements by society presidents on the energy role of each society. The need is for increased domestic supply and improved conservation, which the technical societies can support via information, expertise, and education. TMS can provide improved materials and can devise substitutes for materials in short supply, and ISS can improve energy utilization and design processes to use abundant energy sources (i.e., coal). Export of scrap and coal from energy-short areas was questioned.

Synthetic Hydrocarbons

"Status of Technology": four papers on synthetic fuels - tar sands (by Alberta ERCB's Govier), oil shales, methanol from coal, coal liquefaction.

"Constraints": four papers on financing, manpower and equipment, environmental protection, and government policies.

"Sociological Concerns": four papers on government/public implications in synthetic fuels development, community planning, and public relations.

In general, there seems to be a recognition of the need for a large synthetic fuels industry if the U.S. is to achieve self-sufficiency. To this end, pilot and demonstration plants are being developed vigorously to explore process options.

However, there is marked reluctance by private capital to invest the large amounts required for commercial plants until government is prepared to guarantee price levels or provide financing. The U.S. and Canadian situations show marked similarities in this regard.

(ii) SME

New Industrial Production Techniques: five papers dealing with options for using coal, plant design for energy efficiency, energy management in-plant, use of by-product sulfur, and options for energy supply.

Energy Costs and Resource Consumption: dealt mainly with pollution control in the mining industry.

Materials Handling: five papers on materials handling of oil shale, brown coal, coal transshipping, coal slurry, and multi-purpose piers.

(iii) ISS

The newly formed ISS did not have any sessions specifically aimed at energy, but most of the papers presented are related to the more efficient use of energy or materials, i.e., "Application of the K-T Coal Gasification Process for the Steel Industry" and "Effects of Hot Metal Silicon and Sulfur upon Blast Furnace Coke Rate".

(iv) TMS

Future of Coal: four papers on coal in the overall energy context, conversion to other fuels, metallurgical coal, and labour relations in the coal industry. The same general considerations as those noted in the All-Institute synthetic hydrocarbons session emerged: the need for government support and involvement, and need for a clear energy policy with commitment to goals.

Energy: Use and Conservation in the Metals Industry:

This topic ran through four sessions, comprising eighteen papers. Session I dealt with energy in steelmaking: trends and options, conservation and technology for use of abundant energy, comparison of energy consumption by different steelmaking routes, and nuclear energy in steelmaking.

There is some scope for improvement within existing plant, i.e., in using BOF off-gas, but this is not easy to do. Reduction of coke rate does not seem a sensible goal in view of abundant coal and scarce oil and gas, and likewise direct reduction places increased demand on restricted natural gas supplies. The U.S. may benefit by importing energy in the form of pre-reduced ore from countries with abundant energy, but this runs counter to self-sufficiency goals.

Significant progress is being made in applying the HTGR to steelmaking, and the direct reduction route using nuclear heat with natural gas appears currently economic.

Session II covered non-ferrous metal production: energy use in different types of furnace (reverberatory, electric arc, shaft), stirring by submerged pumps to improve heat transfer to metal baths, energy costs of different metals, energy use in the copper matte furnace, and industrial energy conservation by an aluminum producer.

Session III was concerned with ironmaking: a new continuous process for pelletizing, pre-reducing, and electric arc ironmaking, reduction in a shaft reactor with concurrent fuel gas production, blast furnace injection of coal, and oxygen plant for the blast furnace.

Session IV was a "management" session: minicomputer control of fuel dispatching, energy modelling, demand prediction for the steel industry, and energy control in the processing of Cu, Pb, and Zn.

Materials in Energy Use: comprised eight papers in two sessions dealing with the demands of energy technology on materials.

R. I. Jaffee (EPRI) sketched requirements for materials R&D to develop substitutes and improve capabilities of plant, especially in the electric power industry. Coal gasification and its connection with power generation, and the need for pressure vessels resistant to hydrogen and corrosion/erosion, were stressed. Materials for coal-fired thermal plants are limited to 1000°F, giving a plant efficiency of 40%; some plants operating at higher temperatures have recently been de-rated to avoid excessive attack on materials, and an efficiency of 40% seems to be a limit for current technology. R&D on ceramics could produce a break-through. Attention is being given to engineering design using fluidized bed combustion, closed cycles and combined cycles for steam and gas turbines. In the area of storage, batteries and flywheels are both materials intensive and have potential for vehicular use.

C. J. McMahon (U. of Penn.) advocated focussed research in areas of materials problems, and indicated some possibilities: temper embrittlement of iron alloys which is still troublesome and not yet fully understood, although new techniques such as Auger spectroscopy are improving the situation; intergranular SCC and in-reactor swelling of stainless steel reactor components; and embrittlement of Zr-4 nuclear fuel cladding by iodine.

A. M. Hall (Battelle), outlined research on materials for coal gasification plants. The most critical component is the thick-wall, high-temperature reactor vessel where hydrogen embrittlement and temper embrittlement can occur. Refractory liners are being used.

J. J. Gilman (Allied Chemical) outlined design criteria and materials selection for flywheels for energy storage. Given isotropic material of construction, a shaped wheel with a contour of the form $t/t_0 = (-Cr^2)$ operates at constant stress throughout.

Instantaneous power levels can be very high, and energy storage density better than the best batteries under development if suitable materials are used. A regenerative braking system is now under development for the New York subway by the Garrett Corp.

F. L. Vogel (U. of Penn.) discussed materials for electricity transmission, and reported some previous work on development of Na/polyethylene cables for wiring applications. In spite of some advantages, it is unlikely that Na conductors will replace Cu or Al (preferred recently over Cu for its price advantage). There is some promising work under way on graphite intercalation compounds.

T. G. Byrer (Battelle) outlined a proposal for work on improving the efficiency of metalworking operations, although little response has been forthcoming from small metalworkers for whom the work is intended. As well as the obvious use of recuperators, better refractories especially reflective ones, etc., energy can be saved by warm working rather than hot working, by using preheated rolls, and by avoiding over-specification.

J. D. Frandsen (Rockwell Int.) described work under way in his laboratory to investigate ways to reduce hydrogen embrittlement by introduction of a poison such as O_2 or CO_2 in the hydrogen-bearing gas. Marked effects are observed, and it was suggested that H embrittlement in gas pipelines could be severe if it were not for hydrocarbon poisons.

P. B. Needham (Bureau of Mines) described some of the horrendous scaling and corrosion problems encountered with candidate materials in the Imperial Valley geothermal fields, where significant power generation is planned.

Summary

The sessions involving energy covered the whole sweep of mining and metallurgical technology, and it was apparent at the meeting that energy-related matters are still of much concern in spite of an apparent easing of supply. It has been clearly impossible in this summary to provide any depth of coverage, but the range of societies and topics should indicate the scope of interest. Further details on particular points can be obtained by contacting the author of this report.

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