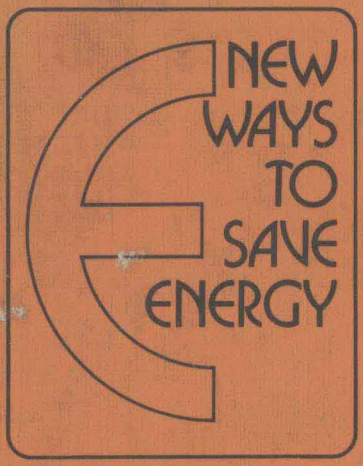

Energy R&D Programme
of the
Commission of the European Communities

Energy Conservation in Industry –

Combustion, Heat Recovery and Rankine Cycle Machines

Proceedings of the Contractors' Meetings held in Brussels on 10 and 18 June, and 29 October 1982

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Edited by

H. Ehringer, G. Hoyaux and P. A. Pilavachi

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PREFACE

The main objectives of the Community's energy policy consist of securing a sufficient energy supply for the present and future demand of its Member States and in reducing the Community's dependence on imported energy through the more rational use of energy and a broader diversification of supply. This requires a full set of common efforts at all levels, including energy research and development.

In the framework of its strategy for scientific and technological research the Commission of the European Communities has launched several R & D programmes in the field of energy. Theses programmes are implemented either directly in its Joint Research Centre or by concluding contracts with research institutions in the EC Member countries.

One of the most important short and medium term objectives of the present four-year Energy R & D Programme (1979 - 1983) approved by the Council of Ministers on 13 September 1979 aims at fostering energy conservation technologies in the three main energy consuming sectors: domestic, industry and transport.

In the European Community more than 35% of the energy is consumed in industry. About 23% of the imported oil is used in this sector. Two thirds of this energy are used for heating purposes. Consequently, there is a high potential for residuary heat recovery.

In order to enhance rational use of energy and energy conservation in the Member States of the Community, it is necessary, among other things, to promote the development of combustion and energy recovery techniques.

The Commission has therefore concluded with industries, public organisations and universities of the EC Member States a number of R & D contracts dealing with combustion and heat recovery techniques. The progress achieved in these contracts was reported in contractors meetings, which took place on 10 and 12 June 1982 in Brussels. There was also a meeting on 29 October 1982 on energy cascading and ORC engines.

The papers presented at these meetings and the conclusions of the discussions are collected in the present book, which is intended to inform the Member States, research bodies and other interested parties about existing R & D work in this area.

I should like to address may sincere thanks to all the authors of papers and speakers of these meetings. I should also thank the chairmen of these meetings, Mr. David REAY and Dr. Giovanni LIMIDO, who animated the discussion with comments and questions. Last but not least, I extend my thanks to the editors of these proceedings, who summarized the content of the meetings and the discussion.

May I express the hope that the work reported will contribute to rapid progress in the development of practical application of improved combustion and heat recovery techniques, thereby contributing to rational use of energy throughout the European Community.

Dr. A. STRUB
Director
Head of the Energy R & D Programme

ATTENDANCE LIST

1. CONTRACTORS

SESSION I : COMBUSTION

Dr. V. SUBRAMANIAN	THE BRITISH ALUMINIUM COMPANY
R.L. McGLASHAN	THE BRITISH ALUMINIUM COMPANY
J.L. ROTH	IRSID
W.E. WHITMAN	LEATHERHEAD FOOD RESEARCH ASSOCIATION

SESSION II : HEAT EXCHANGERS - HEAT RECOVERY

S. GALANT	BERTIN
A. ROJEY	INSTITUT FRANCAIS DU PETROLE
A. GREHIER	INSTITUT FRANCAIS DU PETROLE
J. DREUILHE	CREUSOT-LOIRE
B. CHLIQUE	CREUSOT-LOIRE
M. MISCHIATTI	FBM
C. ANTONINI	FBM
A. CALABRO	TEKSID
D. McCALLUM	JAMES HOWDEN AND CO.
G. CHAFFEY	UKAEA Harwell
J.C. RALPH	UKAEA Harwell
A.D. ROBERTSON	BRITISH STEEL CORPORATION
Dr. R. THORNTON	COURTAULDS
M.C. QUIGLEY	COURTAULDS
M. GROLL	IKE

SESSION III : ENERGY CASCADING AND ORC ENGINES

	H. HOPMANN	MBB
	G. HUPPMANN	MBB
Prof.	E. MACCHI	TURBODEN
	M. GAIA	TURBODEN
	M. FOUCAULT	EDF
	S. GOLDSTEIN	CEA
	B. VRILLON	CEA
Dr.	P.W. O'CALLAGHAN	CRANFIELD INSTITUTE
	M.A. BELL	CRANFIELD INSTITUTE
	MOHEY HUSSEIN	CRANFIELD INSTITUTE
	R.J. WOOD	CRANFIELD INSTITUTE

2. COMMISSION

Dr.	H. EHRINGER	DG XII
	G. HOYAUX	DG XII
Dr.	P.A. PILAVACHI	DG XII
	P. ZEGERS	DG XII

3. CHAIRMEN

Dr.	J. LIMIDO	expert	IFP
	D.A. REAY		IRD

C O N T E N T S

INTRODUCTION

by

Hermann EHRINGER

Commission of the European Communities

Industry consumes 35% of the final energy in the European Community. About 23% of the imported oil is used in this area. Two thirds of this energy are intended for heating purposes. In spite of intensive rationalization efforts undertaken by industry in the last decade, there is still an important energy saving potential, in particular, as regards heat recovery and combustion techniques. Therefore, the European Community supports R & D work on energy saving by means of energy cascading techniques, heat exchangers and Rankine Cycle engines.

The purpose of the contractors meetings is to give the project leaders the opportunity to report on the progress of their work and on the results achieved. Moreover, these meetings serve to establish a link between contractors working in the same area and to strengthen cooperation on a European level.

The papers presented at these meetings and the discussion will be recorded in proceedings which will be published in order to meet the provisions laid down in the Council regulation EEC/2380/74 of 17 September 1974.

SESSION I - COMBUSTION

Chairman: D.A. REAY

Summary of Session I

Efficiency of reverberatory furnaces

Improvements of recuperators associated to steel slab furnaces

Improved boiler control in food factories

SUMMARY OF SESSION I

COMBUSTION

D.A. Reay*), P.A. Pilavachi**)

There are many changes and improvements which can be made to combustion systems to raise their efficiency, and hence conserve energy. Improvements to existing systems can readily be made by "good housekeeping", manual control, and the application of the results of combustion product analysis. Old burners can be replaced by new systems, possibly of the self-recuperative type. A fully automated control system may be adopted, possibly in conjunction with changes in burner type and plant operation.

The 3 projects on combustion, describing activities within the Commission R & D Programme, cover all the aspects mentioned above. BRITISH ALUMINIUM is involved in a substantial programme of modifications to aluminium melting and holding furnaces which has already results in energy savings of 6-7 % on one installation. INSTITUT DE RECHERCHES DE LA SIDERURGIE FRANCAISE (IRSID) is attacking the fuel efficiency problem in another way, by modifying the heat exchangers used to preheat combustion air so that they operate at a higher efficiency. The third project, involving the LEATHERHEAD FOOD RESEARCH ASSOCIATION and a factory in London, centres around the use of a low cost combustion control system on boilers where variable steam demand exists.
(It should be noted that combustion features in several other sectors of the Community Energy R & D Programme, including fluidized beds and heat exchangers/heat recovery).

Efficiency of reverbatory furnaces - The project being carried out by BRITISH ALUMINIUM was established with the initial aim of being able to develop systems and procedures which would save 15 per cent of the energy used in the company's melting furnaces. To date, the work suggests that double this amount will be saved. This has been made possible by three principal measures :

(i) Improved burner specifications, particularly increased turn-down ratio

(ii) Application of instruments

(iii) Automated single-loop control of individual parameters.

Work is in hand which will lead to the implementation of a fully automated multi-loop control system, which will be applied to combustion control. Estimated savings on the three production furnaces involved in the development to date are £ 70,000 per annum (126.000 ECU) and a payback period of 6-8 months is anticipated.

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*) International Research and Development, UK

**) Commission of the European Communities

Energetic optimization of furnaces and heat exchangers - The work at IRSID was not reported at the contractors'meeting. The project has as its aim the saving of energy in reheat furnaces used in the manufacture of steel strip and plates. Because of the high exhaust gas temperatures, the use of radiation recuperators is necessary. These can be of low efficiency, and it is hoped to improve the performance of systems, and also to study the effects of downstream convective heat exchangers. An improved heat recovery system for combustion air preheating should, it is estimated, lead to fuel savings of up to 10 per cent on each furnace.

Improved boiler control in food factories - LEATHERHEAD FOOD RESEARCH ASSOCIATION, in collaboration with PLGROUP (FOODS) LTD is studying cost-effective management of steam supply and distribution in a food factory. This follows on from a broader assessment of energy conservation potential in the food industry completed in the 1st Energy R & D Programme. The industrial partner is active in edible oil processing (see also "Food Industry") and employs three boilers supplying five major steam users and a number of less important ones.
It is intended to collect data on the magnitude and timing of the various steam demands. These data will form, together with information on boiler efficiencies at different ratings, the basis of the input to a micro-computer which will aid assessment of a boiler control strategy.
This project is in its early stages, but the control strategy has been formulated, and awaits quantitative data on steam demand.

EFFICIENCY OF REVERBERATORY FURNACES

Authors : V. SUBRAMANIAN

Contract number : EEB-1-103-UK

Duration : 36 months 1 July 1980 - 30 June 1983

Head of project : Dr V. Subramanian

Contractor : EEC/BA

Address : The British Aluminium Company plc
Technical Department
Chalfont Park
GERRARDS CROSS, Bucks. SL9 0QB

Summary

This paper describes the work carried out in the three stage (instrumented manual, single loop and fully automated microprocessor based control) programme aimed at achieving substantial fuel savings in heavy fuel oil and natural gas fired reverberatory melting and holding furnaces. The programme involves pre- and post-installation monitoring on four selected furnaces. New burners with improved fuel air supply systems, instrumentation and control equipment have been installed primarily for the control of total air/fuel flow, air/fuel ratio and furnace pressure. A selection of instruments and control equipment have been used.

Stage I has been completed. Stage II (single-loop control) is nearly complete and Stage III is in progress. Problems experienced with instruments and control equipment have been reported and preferred equipment has been identified. Use of burners with a high 'on-ratio' turndown and an air damper system has been a major factor in achieving fuel savings. Automatic control of air/fuel ratio using oxygen analysis is considered unsatisfactory.

Savings achieved have been up to:

- 67% on an experimental furnace.
- 45% on factory holding furnaces.
- 29% on a factory melting furnace.
- up to 50% on melting for individual melts.

The estimated savings over the three production furnaces is about £70,000 p.a.