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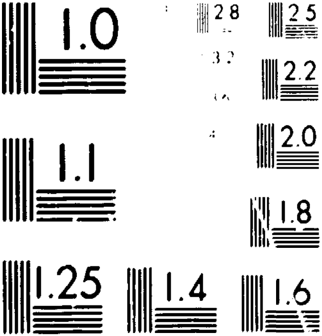
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

WORKSHOP ON PRODUCTION PLANNING AND ENERGY MANAGEMENT IN PETROLEUM REFINERIES

organized by

United Nations Industrial Development Organization (UNIDO)

in co-operation with

the Government of Austria, the OPEC Fund for International Development and ÖMV Aktiengesellschaft

held in Vienna, Austria, from 3 to 19 May 1982

REPORT *

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1. Introduction

The rising price of oil over the last decade has created very obvious difficulties for all countries reliant on petroleum for a major proportion of their energy requirements. These problems seem certain to increase in the future as diminishing reserves and growing political pressures combine to force up the price and reduce the availability of oil. The pressures placed on developing countries by rising oil prices have been particularly severe. Although their petroleum consumption is relatively modest compared to that of industrialized countries, their national economies face considerable problems in coping with these difficulties.

As increased energy consumption is an unavoidable pre-requisite for future economic development, developing countries will have to seek suitable measures to enable them to cope better with the increased energy demand, which still has to be covered largely by petroleum and natural gas.

It is therefore of vital importance that national petroleum enterprises and petroleum refineries are managed and operated at maximum efficiency. This issue was raised during the United Nations Symposium on State Petroleum Enterprises held in Vienna, Austria, in March 1978. It was pointed out that national petroleum refineries in developing countries will doubtlessly not be less successful than multinational petroleum companies if their technical personnel were provided more frequent opportunities, possibly on a continuous basis, to exchange experience and information among themselves on the problems and constraints of their refineries, and keep themselves abreast of the latest developments in petroleum refining.

In line with these recommendations, UNIDO in close co-operation with the OPEC Fund, the national Petroleum company of Austria, OMV and the Austrian Federal Economic Chamber organized its first workshop in the field of petroleum refining "Workshop on Petroleum Processing", held in Vienna from 21 to 30 April 1981. The workshop was intended particularly for those developed countries (LDCs) whose state-owned or state-controlled petroleum refineries are in urgent need of assistance to improve their efficiency and competitiveness.

The workshop programme included the following subjects:

- refinery personnel organization
- personnel training

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- refinery operation
- utilities
- maintenance
- environmental control and energy conservation
- trouble shooting

These subjects were discussed with a view to providing assistance to refinery engineers mainly at a managerial level. Although the objectives of the workshop were largely achieved, it was felt that future workshops should be arranged annually, if possible.

This, combined with the need for more in-depth discussion on selected subjects led to the arrangement of a second workshop, the programme of which focussed only on three topics:

- trends in petroleum processing
- production planning
- energy management

The technical programme of the second workshop, as well as of the first workshop, was conducted by ÖMV, Austria, in their refinery at Schwechat, and included lectures, discussions and plant visits.

For over two decades Austria has owned and operated a successful petroleum enterprise, covering the whole range of oil and natural gas industry, from exploration and production to refining and distribution. ÖMV has erected a modern, efficient refinery at Schwechat to replace the many small, inadequate refineries that existed before 1955 at the oil fields situated in Eastern Austria. The Schwechat refinery is reported to be the largest Central European refinery with a yearly throughput capacity of 14 million tons. The presence of multinational corporations has forced ÖMV to always apply the most modern processing methods, the latest technical knowledge. It is believed that the experience gained by ÖMV could provide useful guidelines for developing countries.

2. The Workshop

Twenty-two developing countries, selected jointly by the organizers, were invited to nominate participants for the workshop. Invitation letters with copies of the aide-memoire and the programme were sent to each government through the UNDP office in the country. The selection of candidates was carried out jointly by the organizers on the basis of information on the candidate's personal background and on information about his refinery which the candidate was requested to provide by filling in a questionnaire.

While the participants of the 1981 workshop were mainly refinery directors and managers, this year's workshop was intended for plant managers, plant engineers and superintendents, specialized in the field of production planning, petroleum processing and energy management.

Ten suitable participants were selected for the workshop (Annex I, list of participants).

2.1 Programme

The technical programme (see Annex II) consisting of lectures, discussions, plant visits and visits to Austrian companies was arranged and conducted by the ÖMV's Schwechat Refinery. For this purpose, ÖMV released about 40 staff members, some of whom were involved for the entire duration of the workshop. The background information on ÖMV and lecture outlines were distributed to the participants each day.

After the Opening Ceremony at UNIDO, the programme started at ÖMV with a moderating session in which all ÖMV workshop staff members participated. The objectives were to enable participants to become acquainted with each other and to further assess specific problems and topics which the participants would like to have included in the workshop programme. The lectures of the workshop programme are summarized in Annex III.

2.2 Opening Session

The workshop was opened by Mr. H. May, Deputy Director of the Division of Industrial Operations and Head, Chemical Industries Branch, at 9.00 am on Monday 3 May, 1982. He welcomed all participants and guests and gave the floor to the following speakers. The main points made by these speakers are summarized below:

Mr. D.G.A. Butaev, Director, Division of Industrial Operations, UNIDO.

"There is no doubt about the importance of managing and operating petroleum refineries at their maximum efficiency. This is precisely the overall objective of this series of workshops, which we hope will continue in future years. The exchange of experience and information and the development of closer working relationships among refinery personnel from developing countries and between them and ÖMV personnel

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should make a real contribution towards raising the efficiency and competitiveness of petroleum refineries in the developing countries. As was recognized at the workshop last year, such co-operation is particularly important for the smaller, state-owned or state-controlled refineries whose problems and constraints are generally different from those of the larger ones. Last year's programme was of necessity a rather general one. Based on the recommendations of the participants, we have arranged a more specific programme this year, concentrating on trends in petroleum processing, production planning and energy management and conservation in refineries. The programme is also longer than last year's. We hope that these arrangements will better meet the needs of the developing countries. In any case, we look forward to hearing your comments and recommendations on further improvements to the programme at the discussions on the closing day.

Last year, we specifically mentioned that "the workshop aimed to identify areas of co-operation among petroleum refineries in developing countries and between them and ÖMV, with possible support of the OPEC Fund and UNIDO". In this respect, I am glad to report that, as an outcome of the workshop last year, we have been able to arrange a technical co-operation project in Trinidad and Tobago Oil Company, TRINTOC, on research and development facilities. The UNIDO consultants involved are two Austrian experts, one of whom is from ÖMV. We hope to be able to establish more projects of this nature."

Mr. Fredrick Hamburger, Counsellor, Alternate Permanent Representative, Federal Ministry of Foreign Affairs, Austria:

"There us a world wide need for an increased transfer of know-how on production planning and energy conservation in petroleum refineries. Training in these fields seems particularly valuable as the production of energy is not only a pre-requisite for industrialization but is in itself a many-facetted industrial enterprise seeking new production methods which will lead to more energy conservation. As this aspect is within UNIDO's energy programme - energy for industry, industry for energy, energy conservation - it will be discussed during the workshop. These issues are of great importance to developing countries and to developed countries as well. For this reason, I hope that the participants and the organizers will mutually benefit from this workshop in gaining new ideas and in finding new solutions to new and old problems."

Mr. Awni Al-Ani, Assistant Director-General, OPEC Fund for International Development:

"The success of last year's workshop in addition to the importance of the subjects dealt with in this year's workshop, has encouraged the organizers for the preparation of this workshop. As you know, the OPEC Fund for International Development is involved in many training activities in more than 80 countries all over the world. We have recognized the importance of training and transfer of know-how and have also noted that it is in fact a very complicated issue. Past experience has shown that technology transfer to developing countries today is less a matter of academic knowledge but more a matter of practical and applied knowledge. I hope that this workshop is designed to offer to the participants an opportunity for further increasing experience in practical as well as in theoretical aspects of refinery problems".

Ms. M. Ottillinger, Vorstandsdirector, Kommerzialrat, ÖMV Aktiengesellschaft.

"In following the recommendations established during the closing session of the 1981 workshop. the present workshop will deal with Production Planning, Processing and Energy Management. It is hoped that the exchange of experience among the participants and with the ÖMV experts will lead to lasting contacts and fruitful co-operation in the future".

Mr. Franz K. Rieger, Director, Austrian Federal Economic Chamber:

"The objectives of this workshop encouraged the Austrian Federal Economic Chamber to participate again. The Austrian Federal Economic Chamber is representing, through its 85 trade delegations in foreign countries, trading companies, industries, tourism, transport and banks of Austria. Also, in the field of energy production, Austrian technology and know-how is available to those interested. It is felt that through co-operation, as demonstrated by this workshop, a valuable contribution is provided towards a better understanding of problems common to all refineries in many countries".

2.3 Closing Day

During the closing ceremony, Mr. D.G.A. Butaev, Director, Division of Industrial Operations, UNIDO, delivered a speech thanking all co-organizers and the participants for their efforts towards a successful workshop and expressed the hope for further collaboration in the energy sector. Mr.F. Hamburger, Alternate Permanent Representative of Austria, commented on the usefulness and importance of the workshop, especially with a view to holding future workshops of the same kind. This was followed by statements from Ms. M. Ottilinger, Director, ÖMV, Mr. Rashid Naas, OPEC Fund for International Development, Mr. H. Lederleitner, Austrian Federal Economic Chamber and Mr. Abas S. Aman, People's Democratic Republic of Yemen, as a spokesman for the participants.

Preceding the closing ceremony, a round table discussion with the participants, the organizers and lecturers was organized to evaluate the workshop programme and to establish recommendations for future co-operation in this field. The workshop conclusions and recommendations are described in the following chapter.

3. Conclusions and Recommendations

It was generally agreed that the objectives of the workshop had been largely achieved and that this year's technical programme covering a large number of lectures in the three topics; petroleum processing, production planning and energy management, was a follow-up of the first workshop held last year. As last year's workshop dealt mainly with issues relating to the general management of a refinery, this year's workshop focussed on refinery engineering activities in detail.

It was felt by the participants from developing countries and by the staff members of the sponsoring organizations who were closely involved in the preparation and conduct of the programme, that the workshop had contributed towards furthering the exchange of practical experience and know-how in accordance with its general objectives.

During the first workshop and likewise also during the second workshop, the participants expressed the necessity of arranging similar workshops annually, if possible. This type of technical consultation meetings plays a significant role for refinery managers and engineers from developing countries to promote co-operation among themselves and/or consult specialist staff on specific problems.

However, more emphasis should be attached to practical experience including on-the-job demonstration activities. In addition, the specific and individual problems which a participant may wish to be discussed should be communicated to the organizers well in advance to enable them to draw up a suitable workshop programme. A more detailed questionnaire to be completed by the participants would help the organizers achieving this aim. This year's workshcp was of a longer duration than last year's. The time for lectures was felt to be adequate, but more time for discussion was desirable. It was also pointed out that the group of participants should be composed of refinery staff with similar background, functions and experience. This year's group proved to be very homogeneous, a fact which contributed towards the success of the workshop.

- Small and/or old refineries
- Maintenance, control and inspection, including net planning for turn-arounds
- Financial management and marketing
- Rehabilitation of plants

A number of other special topics to be covered by these programmes were proposed by the participants, e.g. process selection, project planning and evaluation, engineering standards, utility problems, licensing. It was also suggested to arrange a future workshop in a developing country, using a small refinery as a model, to illustrate the problems common to most refineries in developing countries.

UNIDO's technical assistance programme in the energy sector and the framework under which such assistance can be obtained were introduced to the participants prior to the workshop. Certain requirements were expressed in the field of training, including specialized training courses, fellowships or the establishment of a training centre for refinery engineers. Another request concerns a feasibility study on flue-gas desulfurization.

4. Acknowledgements

The participants from developing countries expressed their appreciation to the organizers and sponsors of the Workshop - UNIDO, the Austrian Government, the OPEC Fund, ÖMV Aktiengesellschaft, the Austrian Federal Economic Chamber - and the Austrian companies who introduced and demonstrated their activities in the manufacture of refinery equipment. They hoped that the Workshop was a starting point for closer co-operation with all the above-mentioned parties.

Annex I

List of Participants from Developing Countries

Country	Name and address of participant
Angola	Mr. Leopoldo Miguel Joa Dias Chagas Trovoada Manager Petrangol Refinery Luanda
Bolivia	Mr. Gaston Prudencio Perez Petroleum Engineer Engineering Director Yacimientos Petroliferos Boliviana (Bolivian Petroleum Enterprise) Casilla 526 Telex: 2376YPFB Cochabamba
China	Mr. Qu Guohua Head of Technical Department Zhe Jiang Refinery Zhe Jiang Province
Costa Rica	Mr. Franklin Omar Williamson Process Engineer Refinadora Costaricense de Petroleo SA P.O. Box "O" Telex: 08512 Recope, Limón
Ethiopia	Mr. Gebremichael Yibalih Head of Planning and Programming Ethiopian Petroleum Corporation P.O. Box 3375 Telex: 21054 Addis Ababa
Mozambique	Mr. Edmundo Ferreira Chief of Chemical Division Refinery PETROMOC E.E. C.P. 417 Telex: 6-479 REFIN-MO Maputo
Sri Lanka	Mr. Dayatatna Chandrasekera Refinery Manager Ceylon Petroleum Corporation Refinery Division P.O. Box 11 Telex: 21167 and 21235 Sapugaskanda Kelaniya
Tanzania	Mr. Thomas F.M. Masili Principal Development Officer Tanazania Petroleum Development Corporation P.O. Box 2774 Telex: 41219, 41005 Dar Es Salaam

Country	Name and address of participant
Turkey	Mr. Cevat Kocaman Refinery Manager, T.P.A.O. Türkiye Petrolleri A.O. Rafineri Müdürü Telex: 42626 Batman
People's Democratic Republic of Yemen	Mr. Adnan S. Aman Senior Process Engineer Aden Refinery Co. P.O. Box 3003 Telex: 210 Little Aden 110
	Mr. Farong Mohsin Khalifa Production Director Aden Refinery Co. P.O. Box 3003 Telex: 210 Little Aden 110

ANNEX II

1. Workshop Programme

3 May, 1982

9:00 OPENING SESSION AT UNIDO

Chairman pro tem: Mr. H. May, Deputy Director,
Div. of Industrial Operations, UNIDO

Opening Speech: Mr. D.G.A. Butaev, Director.
Div. of Industrial Operations, UNIDO

Speeches by: Dr. F. Hamburger,
Alternate Permanent Representative of Austria to UNIDO

Dr. Awni Al-Ani,
Assistant Director-General
The OPEC Fund for International Development

Dr. M. Ottillinger,
Director,
ÖMV Aktiengesellshaft

11:00 ARRIVAL AT ÖMV REFINERY SCHWECHAT

- Welcome by the Refinery Manager — Cech
- Introduction of all Lecturers to the participants — Cech
- Presentation of the WORKSHOP Programme — Pass

12:30 LUNCH in Refinery

13:30 MODERATING SESSION

with WORKSHOP PARTICIPANTS and ÖMV Staff — Huber/Smejda

During this Session, topics of general and special interest will be determined. Although participants have been asked prior to the WORKSHOP to send a short summary describing lay-out, configuration, problems of refinery represented, there may be additional questions/problems which could be determined during this Session. Participants will have the opportunity to set priorities themselves, using the applied "moderating technique."

This Moderating Session will also provide the opportunity to all participants to get acquainted with each other.

4 May, 1982 TRENDS IN PETROLEUM PROCESSING

9:00 Introduction — Krzandalsky

9:10 Trends in Crude Supply — Schrei/Krzandalsky
Situation in Austria, Europe, world; light and heavy crudes, low sulfur/high sulfur crude, influence on refinery structure, price differential for light/heavy crudes, low/high sulfur crudes, metals and asphaltenes in residues

4 May, 1982 (Cont...)

9:30	Discussion	
10:00	Break	
10:05	Trends in Yield Structure Situation in Austria, Europe and other OECD countries; Motorgasoline and Diesel Home heating oil and heavy fuels	Ruttenstorfer
10:25	Discussion	
11:00	Coffee break	
11:10	Trends in Product Quality Motor gasoline: Octane number, lead reductions; gasoline extenders, aromatics, olefines Middle distillates: final boiling point, CFPP, Fulfur Fuel oil: Sulfur, CCR, Heating value, Thermal-stability, metals, sediments, etc.	Lanik
11:30	Discussion	
12:00	LUNCH	
13:30	Trends in Petrochemicals Market situation for olefines, diolefines aromatics, sulfur, methanol, ammonia, feedstock flexibility for steam crackers	Krzandalsky/Ruttenstorfer
14:00	Discussion	
14:30	Coffee break	
14:40	Light Naphtha Isomerization Comparison of different processes Once through and recycle operation Conversion of cat reformers	Pollak/Krzandalsky
15:00	MTBE-production Different processes, different feedstocks	Richter/Krzandalsky
15:20	Discussion	
16:00	End of Session	

5 May 1982

9.00	Continuous Catalytic Reforming IFP and UOP - Process Advantage of CCR (yield, cat lite) OMV-project	Spitzenberger/Krzandalsky
9.20	Discussion	
10.00	Break	
10.05	Urea Dewaxing	Pollak/Krzandalsky
10.25	Discussion	
11.00	Coffee Break	
11.10	Catalytic Dewaxing	Pollak/Krzandalsky
11.30	Discussion	
12.00	LUNCH	
13.30	Visit to Urea Dewaxing plant and CCR-Construction site	
15.00	Gasoil as steam cracker feedstock Yield structure, run length of furnaces	Linskeseder/Krzandalsky
15.20	Discussion	
16.00	End of Session	

6 May 1982

9.00	Introduction to Heavy Ends Processing	Krzandalsky
9.10	Fluid Catalytic Cracking Risercracking, Total Combustion, Power recovery, Feed Desulfurization	Schölm/Krzandalsky
9.30	Discussion	
10.00	Break	

6 May 1982 (Cont...)

10.05	Vacuum gasoil Desulfurization	Steiner/Krzandalsky
10.25	Discussion	
11.00	Coffee Break	
11.10	Visbreaking Flow scheme, yields, stability of product	Steiner/Krzandalsky
11.30	Discussion	
12.00	LUNCH	
13.30	Processes for Vacuum Residue Conversion Coking, Gasification, Hydroconversion, Residue FCC	Krzandalsky/Steiner
14.00	Discussion	
14.30	Coffee Break	
14.40	Auxiliary processes Claus, Hydrogen production, Combustion of Heavy Residues in power stations	Steiner/Krzandalsky
15.00	Discussion	
15.30	Visit to plants	
16.30	End of Session	

7 May 1982

Visits to Austrian Companies and reception by the Austrian Federal Economic Chamber

8 and 9 May 1982 (Saturday, Sunday)

10 May, 1982	PRODUCTION PLANNING	
9:00 - 12:00	A. Introduction to Planning	
	1. Presentation of organizational facts	Schenz/Berger
	2. Tasks - Aims	
	3. Planning Schedule	
12:00	LUNCH	
13:30	4. Planning instruments	Ebner/Hutter
16:00	End of Session	

<u>11 May, 1982</u>	<u>PRODUCTION PLANNING</u>	
9:00 - 12:00	B. <u>Medium-term Planning</u>	
	1. Explanation of yearly production programme	Berger/Schenz
	2. Simulation programme	Grünauer/Hutter
12:00	LUNCH	
13:30	C. <u>Short-term Planning</u>	Rudolf/Schenz
16:00	End of Session	

<u>12 May, 1982</u>	<u>PRODUCTION PLANNING</u>	
9:00 - 12:00	D. <u>Long-term Planning</u>	Vacik/Berger
	D. <u>Special questions</u>	Pletzer/Schenz
12:00	LUNCH	
13:30	F. <u>Laboratory contribution to Production Planning</u>	Csoklich/Lanik
16:00	End of Session	

<u>13 May, 1982</u> Visit(s) to Austrian Companies

<u>14 May 1982</u>

Time:	<u>ENERGY MANAGEMENT</u>	
9.00	Introduction	Cech/Moser
9.15	<u>Energy Management</u> The concept discussed involved: - Human Relations - Organizational Aspects - Technical Aspects Each point will be analysed and proposals for energy management improvement will be presented.	Moser/Cech
10.00	Break	
10.05	<u>Energy Management</u> (continuation)	Moser/Cech
11.00	Coffee Break	
11.10	Discussion	

14 May 1982 (cont....)

11.30	Position of Energy Management within the organization of the Refinery Schwechat - Aims - Responsibilities - Methods of information	Cech/Kögl/Moser
11.45	Discussion	
12.00	LUNCH	
13.30	Possible Alternatives of Energy Supply for a Refinery - Thoughts outlining a refinery "ideally" provided with energy - restrictions existing on account of environmental, political, geographical and technical aspects - Various energy supply systems	Kielhauser/Moser
14.00	Discussion	
14.25	Break	
14.30	Energy Supply and Distribution shown on the example of the Refinery Schwechat, a concept for energy generation and distribution is presented. Special aspects are: - fuels becoming available in the refinery - consequences in respect of combustion and air pollution control - generation of steam and electricity by applying steam/power coupling - water treatment; lime-softened water and boiler feed water - cooling water systems	Schwarz/Moser Reichel
15.25	Coffee Break	
15.35	Energy Supply and Distribution (Continuation)	
16.00	Discussion	
16.30	End of Session	

17 May 1982

9.00	Evaluation of various utilities	Ledochowski/Kielhauser
9.30	Discussion	
10.00	Energy Concepts Energy consumption analysis as a basis for the design of energy-concepts	Taylor/Kielhauser
	Discussion	
10.30	Collection and Compilation of Data on Energy Consumption and Presentation of the Utility Nominal/ Actual Value Comparison (UNAVC)	Bednar/Kielhauser
11.30	Examples of Application of Energy Control Devices	Kögl Taylor/Kielhauser Bednar
	Discussion	
13.00	LUNCH	
14.00	ENERGY CONSERVATION General methods and description of technological approaches to energy recovery and energy saving	Kögl/Taylor
14.15	Discussion	
	TECHNOLOGICAL MEASURES taken or proposed in the Refinery Schwechat	
14.30	a) Measures to raise efficiency in heaters - high efficiency burners (e.g. Coppus) - Air preheating - Waste heat recovery from flue gas	Taylor/Bednar
14.45	Discussion	
	TECHNOLOGICAL MEASURES (continued)	
15.00	b) Computerized automatic heater control	Wilmsen/Taylor
15.15	Discussion	
15.30	c) Cogeneration System/Gas Turbine-Heater Gas turbine cogeneration systems can achieve significant energy saving. The principles of cogeneration are presented.	Schwarz/Taylor

17 May 1982 (cont....)

A special application of the system gas turbine and refinery furnace for cogenerating electrical and thermal energy is discussed.

15.45 Discussion

16.00 END OF SESSION

18 May, 1982 TECHNOLOGICAL MEASURES (Continued)

9:00 d) Optimization of an Exchanger Train by an integrated heat exchanger system in a plant. — Fritsch/Taylor

- Example: crude oil units
- Advantages and disadvantages

9:10 Discussion

9:20 e) Expander Turbines/Reverse Running Pumps — Taylor/Bednar

- for gas streams (especially flue gas of cat crackers)
- for liquid streams (especially on HDS plants)

9:30 Discussion

9:40 f) Low Temperature Waste Head Recovery — Kögl/Taylor

- ORC-Process and heat.heat exchange
- Energy economical comparison of various methods

9:50 Discussion

10:00 g) Optimization of the Insulation of Pipes and Tanks — Schwarz/Taylor/Kaufmann

- main parameters of influence
- method of optimization

A method to optimize thickness of insulation is discussed. The main parameters of influence like installation costs, energy costs and payoff-periods are evaluated

10:10 Discussion

10:20 VISIT to selected locations of interest with respect to energy conservation in the Refinery Schwechat

12:30 LUNCH

14:00 Final discussion — Cech/Pass

19 May, 1982

14:00	Closing session at UNIDO	
	Opening remarks for discussion on Workshop results and follow-up activities by Mr. H. May (Chairman)	
	- Participants' views on the programme - Comments by the organizers - Recommendations on future technical co-operation and follow-up activities	
15:30	Closing ceremony at UNIDO	
	Chairman pro tem:	Mr. H. May, Deputy Director Division of Industrial Operations UNIDO
	Closing Speech by:	Mr. D.G.A. Butaev, Director, Division of Industrial Operations UNIDO
	Statements by:	Dr. F. Hamburger, Alternate Permanent Representative of Austria to UNIDO
		Dr. M. Ottillinger, Director, ÖMV Aktiengesellschaft
		Mr. H. Lederleitner, Department for Foreign Trade and Commercial Policy, Austrian Federal Economic Chamber
16:00	Reception at UNIDO	

2. NAMES AND FUNCTIONS OF LECTURERS

A) SCIENTISTS

Prof. Dr. -Ing. Franz Moser	Dean, Chem. Technology Institute, Technical University, Graz, Styria ÖMV Consultant
Prof. Dipl. Ing.Dr. Fritz Pass	Head: ÖMVCentral hesearch and Development Department; professor at the Technical University, Vienna

B) ÖMV HEADQUARTER STAFF

Dipl. Ing. J. Berger	Deputy head: Production Planning
Dr. B. Ebner	Deputy head: Computer Department
Mr. H. Grünauer	Staff mwmber: Production Planning
Dkfm. H. Huber	Head: ÖMV Training Centre
Dipl. Ing. Dr. H. Hutter	Head: Computer Department
Dipl. Ing. J. Kaufmann	Industrial Engineering Department
Dipl. Dipl. Ing. P. Kielhauser	Senior Internal Auditor
Dr. W. Krzandalsky	Head· Long-range Planning Department
Dkfm. F.J. Ledochowski	Senior Internal Auditor
Dipl. Ing. Dr. H. Platzer	Operations Research
Dr. W. Ruttenstorfer	Corporate Planning.Energy- and Public Affairs
Dipl. Ing. Dr. R. Schenz	Head: Production Planning
Mag. T. Schrei	Crude Oil Supply Department
Dr. G. Schwarz	Dept. Manager of Industrial Engineering Department
Ing. G. Vacik	Staff member: Production Planning

C) REFINERY EXPERTS

Dir. Dr. F. Cech	Refin Manager
Ing. R.F. Bednar	Staff member: Energy Control Depart.
Dr. C. Csoklich	Deputy head: Laboratory Processing
Dr. W. Fritsch	Technologist
Dipl.Ing. B. Kögl	Head of Energy Control Department
Dr. A. Lanik	Head· Laboratory for Processing
Dr. M. Linskeseder	Assistant Plant Manager
Dr. K. Pollak	Technologist

Cont....

C) REFINERY EXPERTS (cont...)

Ing. P. Reichel	Chemist, Power Station
Dr. G. Richter	Asst. Plant Manager
Dipl. Ing. M. Rudolf	Head: Programming and Statistics
Mag. Dr. R. Schölm	Asst. Plant Manager
Dipl. Ing. Dr. E. Spitzenberger	Technologist
Dr. A. Jettmar	Technologist
Dipl. Ing. Dr. D.V. Taylor	Staff Member: Energy Control Dept.
Ing. W. Wilmsen	Technologist
Dr. F. Höfferl	

D) ORGANIZATION

Mrs. L. Smejda	Training Center: Foreign Trainees Dept.

3. BRIEF INTRODUCTION TO ÖMV AKTIENGESELLSCHAFT

ÖMV AKTIENGESELLSCHAFT is Austria's completely integrated, nationalized oil company. While its headquarter is located in Vienna, its operational departments are spread all over the country. The Schwechat Refinery is situated near Vienna.

ÖMV AKTIENGESELLSCHAFT is a shareholding company and operated as such. The shares, however, are owned by the Republic of Austria and made out in the name of ÖIAG (Österreichische Industrie Verwaltungs Gesellschaft), the mother organization administering all nationalized companies in Austria.

ÖMV's capital stock amounts to 1.5 billion Austrian Schillings.

ÖMV AKTIENGESELLSCHAFT has a Board of Directors consisting of 30 members, ten of whom are representatives of ÖMV's employees. The other twenty members are experts, officers of ÖIAG, bank officers and mayors of such towns in which ÖMV's operational departments are located.

ÖMV's Executive Board consists of four members, each one in charge of one of the directorates listed below, and jointly responsible for policy decisions and management of the company. Such decisions to be made unanimously by all four Executive Board members.

The four Directorates are:

- Technical
- Commercial
- Administrative
- Financial

There are three major divisions in the Technical Directorate:

- Production
- Processing
- Projects and Construction

To Production belong the following departments and/or operational departments: geophysics, geology, reservoir engineering, laboratory for exploration and exploitation, drilling, production, natural gas department and the car pool. Also, the "Foreign concession and activities department."

To Processing belong the Central Tankfarm, the Schwechat Refinery, the Central Research and Development Department, Research Laboratories, the Engine Test Station.

Projects and Construction Department designs projects required, constructs, checks-up on constructions and has a special department for pipeline construction. The Central Workshop also belongs to this department.

The Commercial Directorate takes care of buying and selling, i.e. buying:

- Crude Oil
- Products
- other goods required for the operation of the company (purchasing)

and sells products made by OMV.

The Administrative Directorate consists of five departments, i.e.

- Concern Planning
- Concern Controlling
- Personnel
- Training
- General Administration

The Financial Directorate consists of three large departments:

- Finances and financial accounting
- Cost calculating
- Computer Center

OMV AKTIENGESELLSCHAFT's total turn-over in 1980 amounted to approx. 50.6 billion Austrian Schillings (inclusive 5.9 billion AS mineral oil tax).

OMV AKTIENGESELLSCHAFT employed as per 31.12.198:

4.987 blue collar workers
2.856 while collar workers
187 apprentices

8.030 employees in total

OMV AKTIENGESELLSCHAFT participates in many other companies, f.i. owns 100% of its distributing company MARTHA and 74% of ELAN; 51% of ADRIA-WIEN PIPELINE COMPANY. Also has interests in various exploration consortiums in Norway, Canada, Sinai, etc.

OMV's TRAINING CENTER

takes care of all training needs within the OMV concern and offers courses and seminars in:

- management training
- operating personnel training
- day and shift master training
- apprentices' training
- language courses, etc.

Within the Training Center there exists the possibility of training foreigners. Upon exact specification of training needs, "tailor-made" programs are set-up and suggested. Actual training takes place "on-the-job" in the corresponding OMV department(s) either in German or English. The following describes briefly some of training done by OMV in the past:

Iraq

About 20 teachers from INOC PETROLEUM TRAINING CENTER, Baghdad, in the fields of: geology, drilling, production, gas department, central workshop, instrumentation, electrical engineering, car and tractor mechanics, chemistry, pipelines, personnel and training. (From 1 to 6 months).

Several chemists from INOC Baghdad and Basrah were trained in various OMV laboratories (Lab- for exploitation and exploration; laboratory for processing, field laboratories).

OMV's Project and Construction Department built (and trained trainers for) a INOC WELDING CENTER in Basrah. OMV welding experts trained there and four candidates came to Austria for 4 months for additional, specialized training "on-the-job" (pipeline welding).

Nigeria

Eight officers from the Nigerian Federal Board of Revenue trained in OMV headquarter and in the commercial departments of some operational departments (drilling, production, natural gas, etc.) in cost calculation, accounting, mineral oil tax administration, etc. (4 to 6 months each).

China

A group of 9 experts (ranging from geology to petrochemical engineers) visited our organization for 3 weeks for a thorough excursion.

Algeria

Presently a project is being prepared offering the Algerian oil company SONATRACH to train: training managers, trainers to train filling station managers and operating personnel.

Libya

In 1981 a 3 months training took place for Libya's oil company selling organization. Training was in all corresponding commercial departments and another trainee from the same company is expected for similar training in 1982.

UNIDO WORKSHOP on PETROLEUM PROCESSING (1981)

14 participants from 11 developing countries were present last year. The Workshop was so successful that another one is being held this year. Themes chosen for the 1982 workshop were chosen from among demands made by last year's participants and concern:

- Trends in refinery processing
- Production Planning
- Energy Management/Energy Conservation.

ANNEX III

LECTURE ABSTRACTS

A. TRENDS IN PETROLEUM PROCESSING

1. Trends in Crude Supply (T. Schrei)

The paper describes the development of the flow of crude oil and the possible influences on changes of the refinery configuration. Emphasis is given to trends in crude supply for different regions, in particular for the USA, Europe and Austria. It is noted that crude production in non-OPEC least developed countries has increased significantly whereas the crude production rate within OPEC countries has decreased.

Factors like API gravity and sulfur content are determining the price for crude oil and together with crude availability and the prevailing conditions of the market, including the market for fuel oil, will also direct the economy of the refinery processing plants.

2. Trends in Product Yield Structure (W. Ruttenstorfer)

After many years of steady growth in the use of all petroleum derived products in Austria and other OECD countries, the last years have been characterized by a stagnation or even a decline in sales volume. The strongest decrease has been observed with sales of domestic heating oil and heavy fuel oil, whereas the decline in motor gasoline sales is less strong. The changes in the needs for the different end use sectors - industrial, domestic, transport and electricity generation - are analyzed. The result of the analysis indicates that the throughput of the refinery is considerably reduced, which calls for a change in the structure of products.

3. Trends in Product Quality (A. Lanik)

Austria will decrease the lead content of motor gasoline from 0.4 to 0.15 g/l. This will require the construction of an isomerisation plant. But also MTBE will be added and the addition of alcohols is being considered.

The sulfur content of fuel oils will also be reduced in Austria. This will require a change of the crude supply or the construction of desulfurization plants.

As also heavy fuel oil sales decline, the share of vacuum residue and visbreaker residue in heavy fuel oil increases. This means some changes in fuel oil quality. With cracked residues, the problem of stability arises and has to be studied carefully.

4. Trends in Petrochemicals (W. Krzandalsky)

Europe suffers from an overcapacity of LDPE plants. Most steam crackers run at low load, some have been closed down. At the same time, many new plants are constructed in oil producing countries, using cheap natural gas as feedstock.

Cont...

4. Cont...

The low demand of ethylene and the shift to light feedstocks decreases the supply of propylene, butadiene and benzene, which still have a good market. The difficult economic situation forces olefine producers to seek cheaper feedstocks and to adapt their plants: LPG on the one hand, gas oil and even vacuum gas oil on the other hand. A similar situation exists for ammonia and methanol, which can be produced more economically in countries with abundant natural gas resources.

Europe will become an importer of such products.

5. Light Naphtha Isomerization (K.W. Pollak)

A short survey is presented on the chemistry of light naphtha isomerization to produce iso-paraffines with increased octane number suitable for blending with low-level lead gasoline.

The process uses a noble metal catalyst in the presence of hydrogen. Reaction is achieved in two stages: first stage at higher temperature and second stage at lower temperature to favour isomerization reaction.

Redundant reformers and desulferizers can be converted to isomerization plants at relatively low costs.

6. MTBE - Production (G. Richter)

MTBE (Methyl-Tertiary Butylether) is a valuable motor gasoline extender with high octane number. It can be used also to avoid water separation in alcohol-gasoline mixtures.

Feedstock can be C_4-cut from steam crackers, FCC-C_4 cut or mixtures from both.

The flow scheme of a typical plant is discussed. The raffinate can be used as feedstock for other petrochemicals like butene-1, MEK, MA or it can be recycled to the steam cracker.

The high demand for MTBE has led to the development of processes to produce i-butene from n-butene by isomerization or from butanes by cracking.

7. Continuous Catalytic Reforming (E. Spitzenberger)

A higher octane number and higher C_5-yield can be achieved at lower operating pressures. However, this causes rapid catalyst deactivation which requires frequent catalyst regeneration. Two processes (patented by IFP and UOP) are now available for continuous catalytic reforming of hydrotreated heavy naphtha of various origin and composition with a boiling point between 180 to 204 centigrades.

Both technologies allow lower H_2/HC, higher LGSV, higher C_5 and H_2 yields together with a better octane characteristic of the product through processing at lower pressure and temperature than semi-regenerative reforming.

ÖMV has such a plant under cons-ruction which will also supply hydrogen for the desulfurization plant. A reforming index characterizing materials for catalytic cracking is introduced and defined as follows:

$$\text{Reformability Index} = \frac{\text{Naphthenes}}{4} + \text{Aromatics}$$

Cont....

8. Urea Dewaxing (K.W. Pollak)

The urea dewaxing process is designed for the production of parraffines that can form useful petrochemical feedstock. ÖMV operates a urea dewaxing plant for pour point reduction of the heavy gas oils, rendering them suitable as blendstocks in fuel oils. The higher value middle distillates are in this way released from the fuel oil pool. The n-paraffines, which are produced as by-products are either sold as such or are de-oiled to produce a petrochemical feedstock.

9. Catalytic Dewaxing (K.W. Pollak)

Catalytic dewaxing is a relatively new process which uses a Zeolith catalyst for selective cracking of n-paraffines to yield mainly LPG and naphtha. Compared with urea dewaxing there are lower utility costs and less waste-water problems.

10. FCC - Fluid Catalytic Cracking (R. Schölm)

The FCC is a very important conversion process in a modern refinery. First established in 1942 the process has undergone continuous improvements throughout the years. One of the cracker systems used is a "side-by-side configuration" (UOP) which includes a high efficiency regenerator and a quick quench reactor.

The most important development is the use of crystalline molecular sieve catalysts which show a high activity, selectivity and stability. These catalysts are ideally suitable for the short contact time in the all-riser-cracking concept. As a result high gasoline yields are observed with increased RON as well as the ability of sulfur transfer and a large tolerance in metal contaminants.

A modern FCC catalyst promoted with Pt/Pd causes a nearly complete conversion of CO to CO_2 and therefore an increase in the carbon burning rate and temperature.

The emission of SO_2 into the atmosphere can be reduced while using a special metal containing catalyst. The SO_3 formed within the regenerator is converted into metal sulfates and transferred with the catalyst into the reactor to be reduced to H_2S and metal sulfides.

A power recovery system, typically consisting of a catalyst separator, a waste heat recovery system and an expander turbine for electricity generation, has been applied in the ÖMV Schwechat Refinery successfully for the last 10 years. No corrosion problems have occurred.

11. Vacuum Gas Oil Desulfurization (M. Steiner presented by A. Jettmar)

As a result of the Austrian regulation for reduced sulfur content in heavy fuel oils, ÖMV installed a vacuum gas oil desulfurization unit. Instead of adding a flue gas desulfurization unit, ÖMV chose a process (JFP) where the long residue is distilled under vacuum conditions and the vacuum gas oil is then desulfurized through a process, which is essentially a hydrodesulfurization process.

12. Conversion of Vacuum Residues (W. Krandalsky)

Vacuum residues are far more difficult to convert than vacuum gas oil. The most frequently used process today is Delayed Coking. However, with high sulfur feedstock the coke is difficult to sell.

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12. Cont...

Production of synthesis gas by gasification of residue or coke with air/oxygen is a proven process, but very expensive. Through solvent deasphalting, the asphaltenes can be concentrated and thus the size of the gasification plant reduced. Also, combustion of asphaltenes or coke in power stations is possible, if the sulfur emission is controlled.

Hydrodesulfurization of vacuum residue requires high investment and operating costs, especially for residues rich in metals and asphaltenes. Nevertheless, this process will be used increasingly in future as a pretreatment to FCC or delayed coking.

Modern refineries need auxiliary facilities like Claus plant, acid-water treatment, flare system and utility plants.

ÖMV's new Claus plant is designed for high conversion and reliability. It also processes acidwater-stripper off-gas.

Acidwater from different plants is collected and after stripping reused for crude desalting. Flare gases are recompressed and burned in the power station.

ÖMV's power plants are built with a high degree of fuel flexibility. In future, stack gas scrubbing might be necessary to comply with environmental regulations.

Worldwide a tendency for selection of certain processes is observed:

Good Residues:	FCC or delayed coking
Medium Residues:	Deasphalting, Fixed Bed Hydrotreatment followed by FCC or delayed coking, hydroconversion
Poor Residues:	Fluid Coking, Flexicoking, Eureka, Dynacracking, Canmet, Aurabon

13. <u>Visbreaker</u> (M. Steiner presented by A. Jettmer)

Two different visbreaker systems are used - coil and soaker visbreaker - for reducing the viscosity of high viscous feedstock through thermal cracking.

OMV decided for the soaker visbreaker, licenced by Lummus, Netherlands.

The paper describes the operation conditions of the OMV visbreaker and the experience gained with it.

14. <u>Auxiliary Processes</u> (M. Steiner presented by A. Jettmar)

The plants described in the VGO-HDS and the Visbreaker papers do need auxiliary facilities, such as Claus-plants and sour water treatment and, like all other plants, utilities, flare systems, etc.

OMV operates 3 Claus plants, the latest unit having a capacity of 2 x 90 t/d, which was built simultaneously with the VGO-HDS plant. This Claus plant has a two reactor system (each pass), followed by one Claus tailgas treating unit for both passes and one incinerator.

The Claus feed is stripped-off DEA-gas and the sour water off gas. This sour water stripper off-gas contains ammonia, so care must be taken to keep the furnace temperature above 1000°C.

Cont...

B. PRODUCTION PLANNING

15. Introduction to Production Planning (R.W. Schenz)

For a given market situation, the question arises of which product pattern, which crude oil mix or which refinery configuration will be the optimal choice. All these interactive problems are very complex and adequate planning instruments and information systems are required.

The paper presents the organization scheme for OMV and the flow for information necessary for production planning which aims at providing processing schedules on a short-term (approximately one month) on a medium term (approximately one year) or on a long term (approximately five years) basis.

Economic effects, variation in product values and processing agreements are factors which influence decisions in production planning.

16. Multi Periodic Optimization - A Tool for Production Planning (H. Platzer)

A production plan should ideally satisfy the following points:

- to assure a maximum in profits
- to create a minimum in refinery stocks
- to indicate the optimal crude blend
- to meet final product quality

A mathematical model applying linear programming techniques, commercially available, is set up. The basis for the model is a data base arranged in the most practical way. Both model and data base are an excellent support for production planners.

17. CMV Crude Oil Data Base (B. Ebner)

A suitable crude oil data base is a very important requisite in production planning since planning programmes on refinery simulation, annual refinery optimization or monthly refinery optimization depend largely on the same correct crude oil data if comparable results are desired.

Crude oil data is generated through laboratory tests, is estimated or picked up from a handbook or is incomplete. The data base must also be flexible. This, together with the uncertainty of the data input represents a large problem in creating a reliable and useful data base for production programmes.

18. Special Problems in Production Planning (H. Platzer)

a) The Problems

When drawing up a production plan, specific production aspects must be considered, such as:

- At what point in time should a technical facility be serviced so that production is not disturbed grossly?

- Which effect will be brought about by change in specifications of a finished product? What will be the costs?

Cont...

18. Cont...

- What will be the effects on the production plan in the processing regime if one facility is altered?
- Which value should be given to a raw material and to an intermediate or final product respectively?
- A specific amount of one product is to be marketed additionally. Is this possible and what is it worth?
- Can an additional amount of crude be processed?
- A new brand of crude is being offered. Can it be processed and, if so, how?
- A refinery facility is to be constructed. There are several licenses available for the process required. Which of the processes suits the refinery best?
- How does the removal of a specific bottleneck-situation in a facility affect the entire processing unit?

b) Specific Analysis of a Solution of the Refinery-Optimization

With reference to the production plan as developed by means of the refinery optimization, a number of informative data can be obtained from the plan's linear programme. This set of information provides answers to several of these questions. The analysis of shadow prices, e.g., permits the valuation of small raw material and product quantities. Also hints for further planning and production can be obtained using the shadow price information.

c) Comparison of Results from Different Variations

The input-data relevant to a specific problem given into the refinery-optimization-data-base covering the actual production plan and the subsequent calculation of this variation, yield a solution which focuses on the technical consequences which the solution of the problem may have on production.

The comparison of the calculated profit of this variation with the variations used as basis for the production plan, gives the economic effects based on the difference of the calculated profits.

19. Long Term Planning (G. Vacik)

All planning activities covering periods longer than two years are defined as long-term planning. This exercise is based on a refinery optimization programme, the matrix of which is solved through linear programming. The input data covers such parameters as market demand, crude availability and cost, plant availability and capacity, plant yield, and utilities.

A refinery extension programme is established to provide data on the economic effects of construction of new processing plants in the refinery.

Cont...

20. Medium Term Planning (J. Berger)

The yearly production programme is the basis for the crude oil supply and gives the necessary information about the most economical selection of crude oil and product purchases, about expected stocks of crude oil and products in the refinery, about the used capacities of plants in respect to bottle-necks in plants, about input and output of plants, product qualities and mixtures of end-products.

Based on the necessary input data, the procedure of developing the production plan is shown. A large linear optimization programme is the mathematical instrument for the simultaneous planning activity for supply, processing and marketing. The co-operation of the different departments of OMV, which is co-ordinated by the production planning group, is demonstrated.

The various detailed plans, e.g. the stop-plan of the refinery plants, the crude oil production plan for local oil production and the market plan are included in the production programme. A lot of input data is required.

Several questions can be answered by the yearly production plan, such as:

- Which crude oil qualities and what amount of imports are necessary at which period of the year?
- Is the market demand satisfied with the possibilities the refinery configuration offers and the economical demand of the company?
- Which seasonal changes are to be expected concerning used plant capacities and storage volumes or lack of products?
- Which quantities and qualities of energy demands of the refinery itself are expected, taking into consideration all different influences such as seasonal and environmental protection factors, or energy amounts of plants and of the power station?
- Which economical consequences would be caused by changing different parameters like crude oil limits, used plant capacities or chosen plant severity, stock-up of product stocks, etc.

21, Simulation Programme (H. Grünauer)

A simulation programme is used to make results from the annual production plan applicable to a month period. The purpose of the OMV programme, written in FORTRAN, is to produce data indicating the monthly behaviour of the refinery.

22. Short Term Planning (M. Rudolf)

This planning exercise has to be made 10 days before the following month and aims at predicting the size of product stocks at the end of the month. The calculations are based on the following parameters: product stock at the beginning of the month and production and sales of products during the month.

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23. Short Term Planning Instruments (F. Höfferl)

A very important planning instrument is the linear optimization technique, which gives an optimal solution to a system of equations with more unknown quantities than equations. Such a technique is frequently applied in mineral oil or gasoline blending programmes.

24. Laboratory Contribution to Production Planning (C. Csoklich)

Any planning exercise needs a set of physical data, mostly produced through laboratory analysis. The main input from the laboratory is covering the following:

- Evaluation of crude oils.

- Characterization by yield structure (TBP distillation), supplemented by properties of crude, distillates and residues.

  The extent of data provided depends on the nature of information required and on the refinery structure, i.e. on the available distillation and conversion plants.

- Evaluation of straight run distillates and residues as blending components for finished products or as feedstocks for conversion plants.

- Definition of existing relations between refinery and laboratory data.

- Crude oil acceptance tests, providing data for finished product yields according to existing processing agreements.

- Compilation of crude oil data in a crude oil data bank.

- Characterization of SR products and intermediates (as feedstock for secondary processing plants or as blending components for finished products). Considering technical improvements and changes in market demand and quality requirements the following has to be considered:

  - Adaptation of product specifications to increased performance levels in application and with regard to improved environmental protection.

  - Elaboration of blending programmes for finished products.

  - Characterization of new blending components.

  - Evaluation of additives and additive packages supplied by the market.

  - Market control.

25. Processing Agreement (J. Doubek)

The paper describes how OMV makes arrangements with their partners in crude supply and product delivery schedules.

Cont...

C. ENERGY MANAGEMENT

26. The General Problem and how to go about Energy Management in Principle (F. Moser)

Scope

Energy management is a special type of management involving the following factors:

a) Human relations aspects
b) Organizational aspects
c) Technical aspects
d) Economic aspects

As all management problems, also energy management is an intricate complex mixture of all the above aspects.

ad a) Human Relations Aspects

This involves motivation of people. The different means and ways of motivation theory are discussed and practical examples will be given.

ad b) Organizational Aspects

The organizational responsibilities of management and several of the management types will be discussed:

The organizational responsibilities of management:

- define company aims and goods
- planning
- decision making
- delegation of work
- control of work

These can be carried out by several different management systems, e.g. management by objectives, delegation etc.

ad c) Technical Aspects

There are three major areas for application of energy management:

- energy production
- energy distribution
- final energy user

The concepts of management in these areas will be alike in the basic approach but different in details also because of the different magnitudes of possible losses. The basic outline for the Energy Guideline Factor Method of approach to energy management will be discussed for individual process units and total refineries.

ad d) Economic Aspects

Oil refineries are not yet sufficiently aware of the costs and economical aspects of energy saving and energy management. To develop a "cost consciousness" also for energy losses similar to the "throughput consciousness" which does exist among oil refineries, is therefore of considerable importance to make energy management work.

27. Alternative Energy Supply for a Refinery (P. Kiehhauser)

The basic demand of heat and power - having been balanced as well as possible - is satisfied in a combined power and heat station by back-pressure turbine sets with steam extraction.

The combined power and heat station has to have a certain flexibility in order to meet the average fluctuations in power or heat demand.

Peak current will be imported from external suppliers; peak demand of heat (e.g. for the start-up of units) will be produced by internal steam boilers.

To run this model realistically, many restrictions have to be considered, such as the availability of power from external suppliers with all the problems of "secured" delivery, network break-downs, etc. In addition, internal security regulations may cause further restrictions.

Environmental conditions and legal restrictions may make the combustion of heavy oils very difficult.

Various alternative solutions may be suggested such as:

a) Internal supply with central, combined power and heat stations with condensation-turbine sets will cover total demand and even peak demand. To reduce peak demand, waste heat recovery boilers, expanding turbines, organic rankine cycles etc. can be installed today. This system could create over-production of power and heat which could be sold, thereby reducing costs. On the other hand, decentralized, several smaller combined power and heat stations could also guarantee the total internal supply.

b) It is rare that a more-or-less 100% external energy supply is available since purchase of heat-vapour exactly in accordance with given specifications is difficult. Total external power supply is quite realistic, but problems of "assured" availability may arise.

c) The energy supply system which will be selected in most cases is a compromise between the economics and the problems of "assured" delivery. It is a calculated mixture between (a) and (b) above.

28. Energy Supply and Distribution (G. Schwarz, P. Reichel)

Based on energy demands of a refinery, a concept for energy supply and distribution (shown on the example of the refinery Schwechat) is presented.

Taking into consideration the possibility of the combustion of different fuels available in a refinery, the consequences in respect of combustion performance, efficiency and air pollution control are discussed.

The generation and distribution of steam and electricity (especially applying the steam-power-coupling) at different levels of pressures and temperatures and voltages respectively, is described.

Cont...

28. Cont...

Provisions have to be made to supply the energy circuits with different water qualities. Water treatment equipment for producing lime-softened water and boiler feed water, as well as chemically conditioning of water are presented.

General and special aspects concerning cooling water and recycle cooling systems are discussed as the final link in the chain of energy transformation.

29. Evaluation of the Various Utilities (J. Ledochowski)

Before making a decision on any energy concept to be used in a refinery, an evaluation on the alternative utility supply possibilities in terms of economic and technical acceptability must be established.

The traditional solution - as used in most energy balances and flow charts - is based on the absolute energy contents of utilities; i.e. fuel is usually measured in calorific value, heat in enthalpy and power (electricity) in joule or kWh.

This method of evaluation does not take into account the different losses occuring during the transformation of fuel into power (between 15 and 45%) and heat (or more than 90% achievable) and therefore the different input (cost) of fuel to produce 1 kWh power to 1 kWh heat.

Another solution is measuring fuel, power and heat in exergy-units. Exergy is defined as the inherent energy which - within a given environment (mainly temperature and pressure) - can be transformed into any other form of energy.

While fuel and power show high exergy/energy-ratios (fuel more than 90%, electricity almost 100%), heat - especially low temperature heat - shows very poor ratios (f.i. building heating often achieves 5% only). Therefore, 1 kWh electricity is evaluated the same as 20 kWh of heat resulting from a heated building.

A third solution to evaluate utilities is based on the necessary primary energy input (fuel) to create, for instance, 1 kWh heat (at a certain level) or 1 kWh electric power. The necessary input of fuel to produce heat and/or power depends on the technical features of the transformation process. Within a coupling process the problem of apportioning fuel to power and heat arises. The increasing cost of fuels, the various transformation processes and the different value of the utilities indicate the importance of energy optimization with respect to the efficiency of a refinery.

30. Energy Concepts (D.V. Taylor)

A study or survey of a refinery on heat losses is the first and most important step for deciding on measures for energy conservation. But not only capital projects save energy, motivation of the operators to keep household with energy, yields high savings as well.

Before starting a study certain aspects such as scope, economic limitations etc. must be taken into consideration. It is also necessary to have an idea which factors affect energy consumption in the area surveyed.

Modern designs usually take energy conservation into account and set precise goals that are achieved by new technology. The energy balance

Cont...

30. Cont...

and heat loss survey of the refinery Schwechat show the potential for energy recovery that is still available. To realize it intensified efforts must be made in know-how and economics.

31. Low Temperature Waste Heat Recovery (B. Kögl)

Low grade heat is usually defined as that part of waste heat, that is normally rejected to cooling water or air. In refinery processing plants we can assume that heat of product streams rejected to water or air is, in general at temperatures below 200°C with the bulk of the cases being between 90°C and 160°C.

To recover low grade waste heat three different systems are available:

- the traditional heat exchange
- the heat pump
- the Rankine cycle

The paper discusses the essential characteristics and constraints of application and afterwards compares them with each other for a selection mode.

32. Application of Energy Control Devices (D.V. Taylor)

Using the "Final Report" of the "Refinery Energy Profile" printed by the National Technical Information Service, Springfield, USA, the advantages of a short survey of a crude oil unit are described. Examples for the calculation of waste heat rejected to the water or air by coolers are given. The results are plotted in a drawing and first considerations are made on utilization of the available waste heat.

Further the calculation of the efficiency of heaters with an OMV-computer programme is shown. The effect of excess air and the reduction of the flue gas temperature on efficiency is demonstrated briefly.

33. Measures to Raise Efficiency in Heaters (D.V. Taylor)

Heaters that operate without any waste heat recovery equipment have a very poor efficiency. Heater losses originate from high flue gas temperatures in the stack, to a large amount of excess air and radiation from the heater walls.

An important parameter is flue gas temperature indicating energy loss in stacks. Two methods can be applied to reduce stack losses:

- reduction of excess air
- reduction of the flue gas temperature.

34. Expander Turbines/Reverse Running Pumps (D.V. Taylor)

Energy recovery with expander turbines or reverse running pumps can yield considerable sums on savings. Turbines and pumps have controversial advantages and the decision which should be installed has to be made as the case may be.

Methods of regulation and ways of transformation of the generated energy are discussed. A thumb rule for calculation of the performance is given

Cont...

34. Cont...

to make a first check on feasibility and economical viability of an application in a certain system.

The two expander turbines of the refinery Schwechat are described in design and performance - the hydraulic pelten wheel for DEA expansion in the HDS-unit and the four stage expander in the flue gas stream of the FCC-regenerator.

35. Optimization of an Exchanger Train by an Integrated Heat Exchange System in a Plant (W. Fritsch)

Energy conservation by means of networks of heat exchangers is a common feature of most oil and petrochemical processing plants.

Planning how much heat to recover, from which step of a process and where it can best be utilized requires a tool to analyze the process heat requirements.

Methods widely used for tackling network design problems normally consist of:

- data analysis and
- network design

The data analysis yields design targets which correspond to the performance characteristics of the economic optimum network. The analysis is based on the problem data only and is independent of any network structure, yet networks which achieve the predicted targets will be near optimal.

The economical optimization of heat exchanger networks is based on the minimization of:

- utility usage
- number of transfer units
- total heat transfer area

As an example, the redesign of a crude unit heat exchanger train is discussed.

36. Co-generation System Gasturbine Heater (G. Schwarz)

To use energy efficiently, the combination of a gas turbine and a boiler (or a furnace or heater) is a very effective way. Gas turbines can only achieve an efficiency factor of about 35% due to their high mass flow and high exhaust temperature. For conserving energy from the exhaust gas stream, a simple waste heat boiler may be used.

In order to maintain a temperature level appropriate for electric power generation (or e.g. crude distillation), additional firing into the boiler (or, e.g., distillation furnace) linked to the gas turbine is necessary.

Cont...

36. Cont...

Through a cogeneration process, the exhaust gases of the gas turbine (e.g. driving a generator for producing electricity) with a temperature of 450 - 550°C and an oxygen content of 15 - 16% are used for the boiler instead of preheated air. In the boiler, additional fuel is burnt by lowering the oxygen content of the exhaust gas stream to a normal value for flue gas of 1 - 2% or even lower.

37. <u>Collection and Compilation on Energy Consumption. Presentation of a Utility-Nominal/Actual Value Comparison</u> (F. Bednar)

In order to assess energy economics of plants reliable figures on utility consumption on a daily basis are an essential prerequisite. At OMV a computer processed Utility-Nominal/Actual value comparison is done every day to assist the plant management in an economically successful operation of the plant.

38. <u>Determination of Nominal Values by Regression Analysis</u> (F. Bednar)

For the statistical evaluation of test data, multiple regression analysis is applied. This well-known mathematical method provides a tool for finding the parameter by which energy consumption is determined and for indicating the extent to which these parameters are influencial on the energy consumption.

39. <u>Computerized Automatic Heater Control</u> (W. Wilmsen)

A large portion of the total energy supply to a refinery is consumed by the process heaters. In view of increasing energy costs a more efficient utilization of energy has become necessary.

Application of computer control on furnaces, for both, the load and the combustion side, has proved to be an adequate measure for contributing to optimal operation conditions.

Following operations are considered:

- on the load side

  perfect pass balancing
  feed-forward control on load variations

- on the combustion side

  feed-forward control against variations on the fuel supply
  multi-fuel-optimization
  combustion optimization