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(R) Yugoslavia: Aluminium industry.

REPORT

on mission DP/YUG/ 75 / 022/11-59/31.8A

Prepared by P.Gadó expert

SUMMARY

A consultation of two weeks duration was accomplished at the Aluminium Institute for Research and Development in Titograde, Yugoslavia.

UNIDO previously provided several up-to-date instruments to this establishment. Among the instruments a thermal analyser and an X-ray diffractometer were installed, too. During the present mission discussions had been conducted with co-workers of the Institute and the local industrial basis: Kombinat Aluminijuma in order to enhance they consciousness in applying thermal and diffractometric methods in the R + D activities relevant to aluminium production.

Interpretation technique of various measurements was demonstrated.

Literature sources were provided for further studies.

Suggestions are given for the development of the Institute.

Background information

During the last few decades, the country has made considerable efforts to develop its national aluminium industry. As a result, approximately 1.1 million tons of alumina and 300,000 tons of aluminium production capacities per year are currently available. Important bauxite deposits available and hydro-energy resources might justify the consideration at a later stage of a further development in the production of aluminium.

In this context, an Aluminium Institute has been founded within the Kombinat Alumnijuma Titograde /KAT/ in order to further step-up well selected technological capabilities in the aluminium industry by carrying out appropriate R + D activities.

The equipment and the methods available correspond to the overall production structure of the KAT. The plant laboratory is able to carry out on a routine basis the following activities:

a/Chemical analysis

b/Optical investigations

c/Physical studies

d/Mechanical tests.

The Aluminium Institute for Research and Development, working under independent management, is equiped for the following main activities:

a/ Thermal analysis like thermogravimetry, differential thermal analysis, dilatometry;

b/ X-ray diffraction analysis of polycrystalline materials, including powders and metal samples. Identification of unknown phases, quantitative determination of components in multiphase mixtures, texture measurements are possible;

c/ Scanning electron microscopy for morphological investigations and qualitative as well as quantitative chemical analysis by energy dispersive x-ray spetrometry;

d/ Mechanical testing;

e/ Corrosion investigation and electrochemical treatment of aluminium semis for surface conditioning;

f/ Preparation of metal samples by casting, heat treatment, cutting, grinding and polishing;

g/ Metallographic studies by light microscopy.

Chronology of the mission

3rd of November I contacted the UNDP Office in Belgrade to arrange some formalities connected with my trip. On the evening of the same day I arrived by plane to Titograde, met the national project manager and we agreed in my program. Thereafter every workingday I visited the laboratories of the Institute for Research and Development and gave talkes, held advisory consultations and carried out measurements as well as their interpretation in the topics specified in my job description.

On the 15th November I returned tc my home in Budapest.

Partners in fulfilling my job

Mr B.Radonjic, Director, Aluminium Institute

Mr.R.Vasiljevic,
Ms.J.Pavicevic,
Ms.L.Nelevic,
Mr.S.Gluscevic
} co-workers, Aluminium Institute

Mr.M.Kaludjerovic, R + D Laboratory, KAT

Ms.T.Knezevic, Electrode Plant, KAT

Topics of the talks and consultations:

The possible difficulties of sample preparation for thermal and X-ray diffractometric measurements. Concerning the latter especially particle size and preferred orientation were considered.

Potential uses of thermal,diffractometric and SEM methods in the characterization of bauxite, alumina, electrode materials and aluminium alloys were reviewed.

Differences in the sensitivity and accuracy of measuring arrangements like thermogravimetry /TG/, differential thermal analysis /DTA/, differential scanning calorimetry /DSC/ and differential thermogravimetry /DTG/ in thermal analysis and like monochromatic diffractometry, variable width slit system, horizontal or vertical goniometer in

X-ray diffraction, were elucidated.

The correlation and complementary nature of data obtained by various physico-chemcal methods available in the Institute, have been analysed. Ways of quantitative multicomponent mineralogic analysis of bauxite and red mud were followed and discussed.

Methods used and results gained were compared critically with the experience acquired by the partners during their recent study trips under the project to Aluswisse and ALUTERV-FKI Laboratories, respectively.

Novel publications and sources of reference data connected to thermal analysis and X-ray diffraction measurements were provided.

Conclusions and suggestions

As a result of direct Unido support the Aluminium Institute in Titograde is in possession of instruments for materials research of high technical value and capacity. Research workers of the Institute gained a lot of experience corresponding to the relevant methods. Maintenance and continuous running of these instruments, however, seems not to be fully solved. Instruction manuals, accessories, desirable infra-structure and services are not always available. The number of operators and scientists seems to be less than optimal for the exploatation of the capabilities involved and for a fruitful team work of specialists with different background but convergent interests.

Problems, which should be tackled in this Institute for the benefit of the Yugoslav Aluminium Industry are as follows:

i/ Identification of minerals present in bauxite,red mud, alumina and other inorganic materials produced

within thé Bayer process /scales, special kinds of alumina/ and used in the Hall-Herault electrolysis / cryolite and electrode materials/ by X-ray diffraction;

ii/ Quantitative multicomponent analysis of the materials mentioned under i/ above by combined chemical, X-ray diffraction and thermal analysis;

iii/ Morphological investigation and particle size analysis of the materials mentioned under i/ above by scanning electron microscopy;

iv/ Characterization of the texture in semi- and finished-products by X-ray methods;

v/ Extensive use of computer evaluations of data acquired in the measurements i - iv/ above;

vi/ Research work to describe in detail the processes occuring in course of the technology applyed for alumina refinement and electrolysis;

vii/ Finding the causes of failures in the production , reject analysis;

viii/ Developing methods and instruments for process control.

Publications handed over to my partners

1/ Sanders,S.R.:Determination of Alumina and Iron Phases in Bauxite by DTG Analysis.
A paper presented at the Jamaican Bauxite Symposium, 1985

2/ Gill,Ph.S.:Thermal Analysis: Developments in Instrumentation and Applications.
American Laboratory, 1984.jan.

3/ Loehr,A.A.: Derivative Thermal Analysis.
Paper 92 at the Pittsburgh Conf.on Anal.Chem. and Applied Spectr. /1982.03.07/

4/ Paulik,J.,Paulik,F.,Arnold,M.: Derivatograph-C.
Hung.Scientific Instr. 59,7-62, 1985.

5/ Bayliss,P.:Quantitative Analysis of Sedimentary Minerals
by Powder X-ray Diffractometry.
Powder Diffraction 1,37-39,1986

6/ Jenkins et al.: JCPDS - International Centre for Diffraction
Data - Sample Preparation Methods in X-ray Powder
Powder Diffraction, 1,51-63,1986

7/ Smith,D.K.: PDF Workbook. A course-book for studying the
basic manual methods of identification of mineral
phases using the JCPDS Powder File, 1985.

8/ McCarthy,G.J.: JCPDS Johnson Search Match Program.
A Discussion Paper presented on a satellite work-
shop held on the XII.Congress of IUCr,Hamburg,1984.

Budapest,1986.12.15.

P.Gadó