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DRY BATTERIES FACTORIES

SI/EGY/85/802

EGYPT

Technical report: Short-term Technical Assistance * in the field of Dry Batteries Manufacturing

Prepared for the Government of Egypt
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Jerzy Kwaśnik
Expert in Dry Batteries Manufacturing

United Nations Industrial Development Organization
Vienna

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Contents | Page

1. Course of the mission

1.1 Duration: 20/1/1986 - 2/2/1986

1.2 Duty Station: General Company for Batteries
Dar El Salam, Cairo, Egypt
(Tel: 848263; Telex: 93771 UN

1.3 Purpose of Project:

To provide the Government of Egypt with assistance to Electrolitic Manganese dioxide/EMD/production for dry batteries.

1.4 Duties:

To evaluate techno-economically the existing production facilities with special reference to specifc chemical processes concerned.

To assess present and future needs with respect to EMD manufacture and assist the company in improving the existing plant production.

To submit a detailed report reflecting the course and results of the mission, especially in view of specific conclusions and recommendations to meet present and future needs.

1.5 During my stay in the factory I was introduced to the production process. The electrolysis was finished before my arrival and during my stay there, preparation work was done for a new electrolysis cycle. As there were no facilities to make full analysis of the raw material half-products and EMD and because of the short duration of the mission (8 working days) I decided, in agreement with the UNDP Office Cairo, to take some samples with me and test them in Poland.

The results will be an appendix to this report.

The co-operation with the factory management and staff were very good. I was working with:

- Jehia M. Kotb - Chairman of the Company
- Mohamed A. Mostafa - General Director
- Dr. A.A. El-Kawy - Plant Manager
- Ossama E. Elaktaa - Quality Control Manager
- Ibrhim M. Salmy - Quality Control Manager

From the UNDP Office in Cairo I received all the necessary assistance required.

2. The techno-economic evaluation of the existing production facilities

Installation and know-how was bought in 1964 from the firm Vidor, Great Britain. It was designed for the capacity of 5 tons EMD per week, it means 250 tons per year. The know-how was adapted for the use of raw material and ore containing min. 84% of MnO_2 and for use as electrodes lead.

After installation, the equipment was never used for full production. After some tests with lead electrodes a change was made to graphite in 1977. In 1985 preparations for the production were started again. As a result of this, the first EMD was received in January 1986.

Taking into account the state-of-the-art in the year 1964 and the supposition of 5 ton per week production scale and use of high grade ore, 84% of MnO_2, the installation was designed correctly; but even at that time there was doubt about the use of such high quality material and the economy of such a small scale production.

Taking into account the techniques available in 1986 I confirm that a production capacity of 250 tons per year is too small for making the most economical use of the equipment.

In conclusion, this installation could be used successfully as a pilot installation for working out an economical industrial process of EMD production, especially now that there is a need to change the raw material from the high grade 84% MnO_2 ore to an ore containing 68% - 70% of MnO_2 only. This will cause some changes in the production process.

3. Recommendations for the improvement of the existing production facilities

3.1 Because of the decision to use an ore with 68% - 70% of MnO_2 there is a need to elaborate some changes in the existing technology.

3.2 For such an ore to develop the reduction process, the most economical way will be by using a rotary continuous reduction furnace.

Before elaborating a proposal, some tests must be done with the ore and an available cheap reducing agent - charcoal, coke, oil - and a heating agent as well, - gas or coal dust.

3.3 To elaborate the reduced ore leaching process. The methods of purification depend on the used ore. If heavy metal impurities are present the solution after oxidation of Fe^{2+} ion has to be purified by adding CaS or BaS.

3.4 To make some tests changing the surface treatment of the graphite anodes, the current densities and the time of the electrolysis.

3.5 To make economic calculations and tests using titanium anodes.

3.6 To make tests with other filter materials. For the expansion program to analyse the use of continuous vacuum filter.

3.7 To introduce re-cycling of water, first of all the water used for washing the EMD.

3.8 To start the development work in optimization of all operations to save materials, energy and labour.

4. Conception of the extension of the EMD production

Taking into account the future consumption of EMD in Egypt and the possibilities of export to neighbouring and other countries, a conception should be analysed for a site for the building of a factory with the capacity of 2,000 - 4,000 tons per year. It could be built in stages.

The following should be taken into consideration when deciding on the site for the factory:

- near the ore deposits
- near the biggest user of the ore, that means the metallurgical industry
- extension of the production in the existing factory

There must also be a good supply of electricity and clean water.

For this factory, it would be a good idea to consider the erection of production facilities for other Mn salts, for instance for the fertiliser industry and as an addition to the animal food industry.

The Government of Egypt would have to consider the realisation of this project by co-operation with a foreign company which has the necessary experience.

5. Conclusions

5.1 To achieve greater efficiency from the existing installation it is recommended to introduce changes and proceed with development work proposed in section 3 of this report.

5.2 It is very important to establish the raw materials source for a longer period of time and for this material to work out the production process and the changes to existing installation.

Such a project could be elaborated by Central Laboratory for Accumulators and Batteries - Forteczna Str. 12/14, 61 - 362 Poznań, Poland.

5.3 There is a need to create conditions for making the full analysis of raw materials half-products, and for making technological experiments on a laboratory scale. Training in this field could be organized in Poland or by Polish specialists in Egypt.

5.4 After having full information about the ore deposits and electricity and water supply, it is recommended that the extension conception proposed in Section 4 of this report be considered.

5.5 The analyses of the results of the samples taken from the factory and additional information about the rotary furnace and Mn salts as byproduct of the EMD production, will be given as an appendix to this report.

Test results of materials received from Egypt

No.	Material	Humidity %	MnO_2 %	Mn tot. %	Fe %	Cu %	Ni %	Co %	Species insoluble in HCl %	Activity	Spectral analysis	Phase composition
1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Sample of Electrolytic MnO_2 /lumps/	0.56	89.6	62.1	0.018	0.0003	0.003	spectr. absent	0.26	28.5	Mn, Ca, Pb, Mg. traces: Al, Cu, Si	medium - crystalline gamma MnO_2
2.	Sample of EMD /Powder/ before washing	0.85	74.0	53.4	0.3	0.011	0.006	-"-	14.1	21.2	not tested	not tested
3.	Sample of Natural MnO_2 Ore /Powder/ Sina origin - high grade	0.95	01.4	55.5	1.38	0.12	0.019	-"-	5.6	10.6	Mn, Ba, Sr, Ca, Cr, Al, Pb, Ni, Cu, Fe, Si, Mg.	Beta MnO_2 dominates, unidentified deposit in the background
4.	Sample of reduced ore /MnO_2/ /sina origin high grade/	0.09	3.0	61.5	1.30	not determined	0.017	not determined	14.2	not tested	Mn, Ba, Sr, Ca, Al, Pb_{tr}, Ni, Cu, Fe, Si, Mg	MnO_2 and deposit, dominate
5.	Natural MnO_2 Ore /lumps/, Sudan Origin - low grade	2.3	67.0	53.4	1.28	0.004	0.007	-"-	11.0	14.5	Mn, Ba, Sr, Al, Pb_{tr}, Ni, Cu_{tr}, Fe, Si, Mg	beta MnO_2, lithioforite and other mineral components from the group of psilomelane, less β-MnO_2 than in Egyptian ore

dr Jerzy Kwaśnik

APPENDIX

The following parameters were tested:

- MnO_2 content; Mn total and major impurities such as Fe, Cu, Ni, Co and species insoluable in HCl.
- phase composition
- impurities by means of spectral analysis
- activity, i.e. discharge time of a test cell

Evaluation of sample material:

1. Sample of electrolytic MnO_2/lumps/ has relatively low MnO_2 content. Electrolytic manganese dioxides usually contain 90% MnO_2 and sometimes exceeding 93%. With the Polish technology it is possible to obtain EMD with MnO_2 content in the range of 90.9 - 93.4%. The amount of impurities in Egyptian EMD sample complies with Polish requirements.

2. Sample of EMD/powder before washing contains large amount of species insoluble in HCl, hence low MnO_2 content. We expect this is due to high content of graphite from the electrode which entered the product accidentally as impurity. Therefore, we consider this sample as individual, incorrect case.

3. According to the preliminary evaluation, Sudan origin low grade ores are suitable for the production of electrolytic MnO_2 with Polish technology,