CHAPTER I

EXECUTIVE SUMMARY

1.1 TYPES OF DRY CELL BATTERIES

The first dry cell discovered in the late 19th century consisted of zinc anode, manganese dioxide cathode and gelled mixture of ammonium chloride and zinc chloride as electrolyte, the dry cell being commonly known as carbon zinc Leclanche cell. Even today, major production of dry cells in the world is of this type, since these cells are lowest in cost and are most suitable for applications requiring intermittent use, such as flashlight and transistor receivers. However, these cells have low energy density and limited shelf life.

A large number of new systems for dry cells were developed after World War II to meet the requirements of new applications such as motorised equipment, miniature applications such as hearing aids and watches, for communication equipment etc. These new cells have higher energy density and better shelf life, better discharge characteristics etc. Most important of these new systems and their applications are given in Table 1.1

1.2 INDIAN DRY CELL MANUFACTURING INDUSTRY

Indian dry cell industry dates back to 1926 when Eveready Company (G.B.) Limited started manufacture of dry cells in Calcutta. In the first decade after World War II three more units were established with foreign collaboration. However, the real growth of dry cell industry took place after 1970, coinciding with the boom in transistor radios, when as many as seven units were established, with foreign collaboration. Out of the 11 major units set up between 1945 and 1985, four units have closed down due to various reasons and now only seven main units are in regular production. One more unit was set up recently at Pune for the manufacture of dry cells required for defence applications with technology and know how

Table 1.1

NEW DRY CELL SYSTEMS AND THEIR APPLICATIONS

S.No.	System	Applications
1.	Alkaline Zinc-magnese dioxide	Cassette players, tape recorders, calculators, movie cameras, and other high drain applications.
2.	Zinc-mercury oxide	Hearing aids, wrist watches, medical electronics, military receiver transmitters etc.
3.	Zinc-silver oxide	Hearing aids, wrist watches, instruments, photoelectric exposure devices, missiles and space applications.
4.	Zinc-air	Flashing barricade lights, navigation aids, hearing aids, electronic watches.
5.	Magnesium-maganese dioxide	Military receiver transmitters, aircraft emergency transmitters.
6.	Nickel-cadmium	Alarm systems, electric shavers, dictating machines, instruments, tape recorders, radio transmitters movie cameras etc.
7.	Lithium-sulphur dioxide (Li-So_2)	Under water mine batteries, life support equipment, space probes, missiles, security systems, electronic counter measures, covert sensors etc.
8.	Lithium-thionyl chloride (Li-$SOCl_2$)	All those for Li-So_2 systems plus high temperature applications.
9.	Lithium-Vanadium Pentaoxide (Li-V_2O_5)	Applications requiring extremely long life and relatively low discharge rates, covert sensors, implentable medical devices, watches.
10.	Lithium-Polycarbon monofluoride $(Li\text{-}CF)_8$	Electronic watches, calculators and I.C. memory back up, LEDs, lighted flashing floats cameras etc.
11.	Lithium-Iodine (Li-I)	Cardiac pacemaker, memory circuits.
12.	Lithium-iron disulphide (Li-Fes_2)	Mostly military uses for applications requiring instant power, short operating life, high energy density & long shelf life.

developed indigenously. Their licensed capacity, installed capacity and production for 1984-85 are given in Table 1.2 below :

Table 1.2

CAPACITY & PRODUCTION OF MAIN DRY CELL UNITS (1984-85)

		(in million nos.)		
S.No.	Name of the firm	Licensed capacity	Installed capacity	Production
1.	Union Carbide India Ltd., Calcutta	507	917	527.80
2.	Indo-National Ltd. Madras	195	220	240.00
3.	Lakhanpal-National Ltd., Baroda	180	180	211.00
4.	Geep Industries, Allahabad	222	196	87.10
5.	Toshiba Anand Batteries, Cochin	90	72	58.59
6.	Punjab Anand Batteries, Chandigarh	120	42	43.44
7.	Apte Amalgamations Sholapur	60	15	6.94
	TOTAL :	1374	1642	1174.87

Almost 99.9% of the present production of about 1200 million, dry cells in the country is of cylindrical cells in the conventional carbon-zinc Leclanche system. Silver oxide button cells form a very small percentage of the total production. Between the decade 1975 to 1985, the production of dry cells in the country has doubled showing an annual compound growth rate of about 8%. Assuming the same growth rate, the production of dry cells in the country is expected to reach 2500 million by 1995.

1.3 TECHNOLOGICAL STATUS OF DRY CELL BATTERY INDUSTRY IN INDIA

1.3.1 DRY CELL BATTERY TECHNOLOGY

Dry cell Battery Technology involves :

i) Design and construction of dry cells.

ii) The manufacturing technology of dry cells.

iii) Design of dry cell batteries.

Development of dry cell designs has proceeded in two directions. i.e. (i) Discovering new electrochemical couples together with suitable electrolyte to improve one or more of the major characteristics of dry cells for different application (ii) Construction of the cells and development of suitable raw materials and materials of construction particularly the seals to ensure leak proof construction.

Manufacturing technology of dry cells involves selecting suitable plant and machinery for producing various components of the system and design and manufacture of a specialised assembly line to ensure high productivity.

Technology of the dry cell battery design involves designing of suitable container for accommodating a number of cells arranged in series and/or in parallel to provide higher voltage and/or current than is possible with single cells and to design suitable external terminals.

1.3.2 PRESENT TECHNOLOGICAL STATUS

Because of the substantial growth planned for the electronics industry, new applications for dry cells will open up both for civil and military equipment,and while dry cells of carbon-zinc Leclanche type would still be required in very large numbers, new systems having higher energy density, better discharge characteristics and longer shelf life would have to be developed within the country. A study of the main dry cell manufacturing units has indicated that although most of them have set up R & D organisations for upgrading the technology acquired by them from their foreign collaborators, their R&D activities are mostly directed towards substituting imported raw materials with indigenous ones, and for designing batteries for defence applications. The dry cell industry in India has not acquired the requisite technological maturity as can be judged from the following criteria.

The industry generally has not developed capabilities to develop new systems and types of dry cells, since most of them look to the foreign collaborators, whenever they feel the necessity of introducing cells in new systems. The only exception in this respect is that of Bharat Electronics Limited who have developed magnesium cells indigenously with the assistance of Indian Institute of Science, Bangalore.

In regard to the manufacturing technology, the industry has again not developed capabilities to design and to construct production lines on their own. Whenever they desire to improve production, they again approach the collaborators for supplying the necessary plant and machinery.

The only area in which the industry has developed capabilities is in respect of the design of batteries required by defence and for designing suitable seals for the cells.

1.4 TECHNOLOGICAL DEVELOPMENTS ABROAD AND THEIR RELEVANCE TO INDIA

A large number of new systems listed in Table 1.1 have been developed abroad and are manufactured and marketed by a large number of firms. New applications are opening up for these dry cells for use in the civil as well as military equipment. These applications include bulk energy storage communication satellites, military communications, space vehicles, auto vehicles etc. Indian industry should take advantage of these developments and should not be left behind in this field. The systems which would particularly need to be developed under Indian conditions are :

i) Alkaline manganese dioxide cells.

ii) Mercuric oxide cells.

iii) Nickel cadmium cells.

iv) Zinc-air cells.

v) Lithium poly carbon-monofluoride cells.

Developments abroad in the manufacturing technology have resulted in highly productive assembly lines capable of producing 900 cells per minute. The demand for dry cells in the country is likely to double over the next decade and it is important for India to develop capabilities to design and construct such highly productive lines.

1.5 GAPS IN INDIAN TECHNOLOGY AND SUGGESTIONS FOR CLOSING THEM

In regard to the products currently being manufactured by the dry cell battery industry in the country, the most significant gap in technology is the non-availability of the raw materials of requisite quality indigenously. The raw materials in order of importance are zinc of 99.99% purity, Electrolytic Manganese Dioxide (EMD), Natural Manganese Dioxide (NMD), carbon electrodes and ammonium chloride. Zinc of the quality required is not yet produced by Hindustan Zinc Limited or Comminco Binani Limited. One of them should be persuaded to produce the same at the earliest. Manganese ore available in India does not have the proper structure and contains impurities which are harmful to the life of the battery. One of the National Laboratories should be persuaded to take up beneficiation studies of the Indian ore with active participation of one of the dry cell manufacturing units. The remaining three items are produced in the country but are not adequate to meet the demand. Although many parties have taken letters of intent for these, no progress is made by them in implementing the projects. DGTD should cancel these letters of intent which are blocking the capacity and should encourage parties who are genuinely interested in setting up their production.

Another most important gap in technology is in the capabilities to design and develop the cells in new electrochemical systems which are in commercial production abroad and are likely to be needed for civil and military uses in India. This gap could be closed by undertaking collaborative R&D between the Dry Cell Industry and some of the National Laboratories like Central Electrochemical Research Institute, National Metallurgical Laboratory, Indian Institute of Science etc.

Another gap is in the manufacturing technology viz capabilities to design and manufacture highly productive lines. This problem could be tackled by collaboration between the dry cell manufacturers and specialist firms who design and construct material handling systems.

1.6 MAJOR RECOMMENDATIONS

- Indian Zinc manufacturers may increase production of 99.99% purity zinc to meet full requirement of zinc anodes for the dry cell battery industry.

- Additional units may be encouraged for manufacture of EMD/CMD, to curtail imports.

- Govt. may sponsor studies into beneficiation of Manganese ore with national laboratories such as, NML CECRI to curtail imports of NMD.

- Additional units may be encouraged for manufacturing carbon electrodes for batteries.

- There is a need to design and develop high productive manufacturing lines for dry batteries capable of producing 900 cells or more per minute for more economic production.

- Collaboration between industry and national laboratories should be encouraged for developing new types of batteries.

- Foreign collaboration for carbon zinc batteries should not be permitted. For other types of batteries it may be permitted where national laboratories/institutions do not have the technical knowhow.