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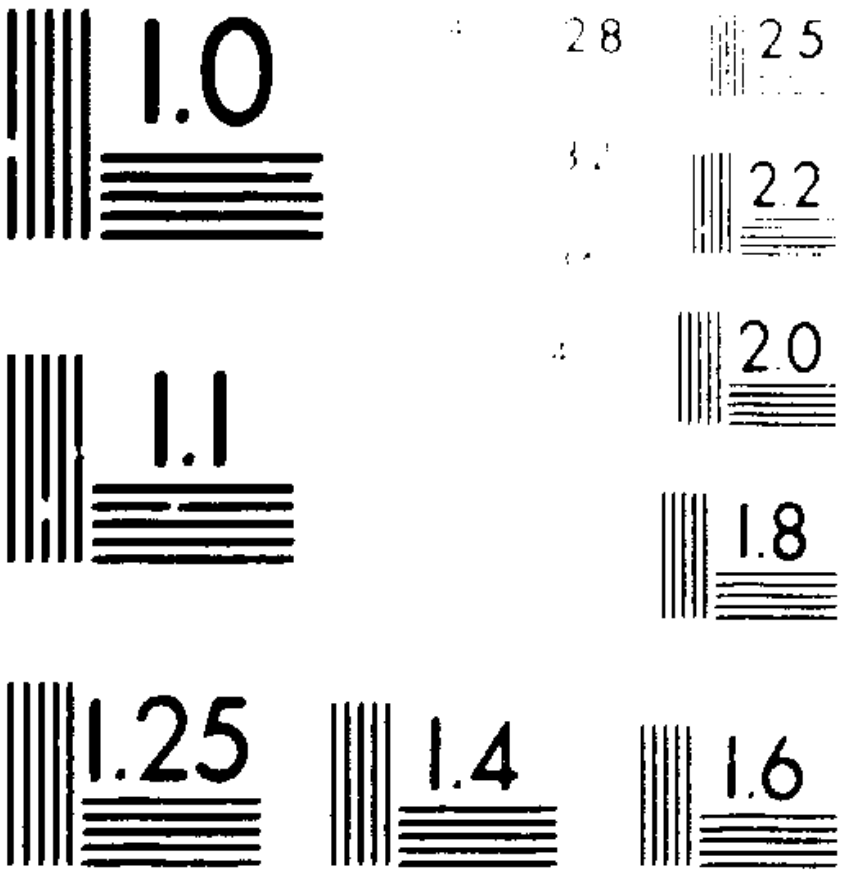

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RESTRICTED

4th December 1982
English

PROJECT IN INDIA (plant operations, polymer units).
JOB DESCRIPTION

DP/IND/73/010/11-01/32.1.H

2nd terminal report

Prepared for the Government of India by the United Nations Industrial Development Organization, executing agency for the United Nations Development Programme.

Based on the work of Ivo Bedrna,
adviser in Plant Operations (Polymer Units)
Indian Petrochemicals Corporation Limited, Baroda.

United Nations Industrial Development Organization
Vienna

I. EXPLANATORY NOTES

Technical and local capital letter abbreviations used in the report:

IPCL:	Indian Petrochemicals Corporation Limited, Baroda, Gujarat, India.
PP:	Polypropylene
LDPE:	Low Density Polyethylene
PBR:	Polybutadiene Rubber.

II. ABSTRACTS

Project in India for IPCL

Post: Adviser in Plant Operations (Polymer Units)

Job Description: PD/IND/73/010/11-01/32.1.H.

Duration: Six month begining 19th October 1981, ending 22nd April 1982. Extension for three months begining 4th August, 1982 ending 4th November 1982.

Duties: To assist the Operation's Manager in all operational aspects, to assist in forecasting any operational and processing problems, to ensure a trouble free and efficient operation of PP, LDPE and PBR Units.

Note: A terminal report was prepared by the expert by finishing the original duration of the mission. This 2nd terminal report coverts only the extension period. Main conclusions and recommendations are mentioned in the first terminal report. No changes of the recommendations due the extension experience are necessary.

III. TABLE OF CONTENTS

IV. INTRODUCTION

Indian Petrochemical Corporation Limited (IPCL) is a Government undertaking, with over five thousand employees. It operates 11 petrochemical plants, including three Polymer Plansts:

A) Polypropylene unit (PP)
B) Low Density Polyethylene Units (2 lines) (LDPE).
C) Polybutadiene Rubber Unit (PBR).

IPCL Headquarter was established in Baroda, Gujarat. Marketing offices in Baroda, N. Delhi, Bombay, Calcutta and Bangalore has been also established. In addition to the production units IPCL has a Research Centre with excellent laboratories and a huge Applications Centre for Plastics and Rubber.

The original mission of the expert began in October, 81 and ended in April, 82. Before the end of the mission IPCL asked for a three months extension. Due to necessary formalities the extension was only possible to continue in the second half of 1982.

In comparison with the information in the first terminal report, some personal changes took place. So Mr. Y. R. Trivedi is the Operational Manager now and the new Deputy Operation Manager for Aromatics and Polymers is Mr. M. V. Naik.

During the extension, as on the original assignment, the expert was provided with an office room and daily transport to the factory.

At the beginning of the extension, it was agreed between the expert and his counterparts, that most of the experts time would be spent in PP Plant helping to solve problems of capacity and quality and the reminder of his time in LDPE Plant, assisting to solve problems together with Applications Centre of different requirement by customers.

The main recommendations were reported by the expert in the first terminal report and these recommendations are still valid, some additional recommendations are mentioned in the following chapter.

V. RUNNING OF THE MISSION

The expert during this period attended only two polymer plants - PP and LDPE units, as was agreed between him and his counterparts at the beginning. The PBR unit was covered during the last month of the previous term and recommendations given to IPCL about this plant are connected to this report as a separate section.

On the PP Plant

The main concern was about the capacity problems. The bottlenecks in this plant are in following parts of the unit:

Solvent recovery section

The reboiler of the heptane recovery column is often blocked with polymer and as the spent and fresh solvent tanks are relatively small, the polymerisation is to be stoped. The cheapest and simpliest way to overcome this problem is to join a spare reboiler parallel to the old one, so in case of choking one can be cleared and the other one can be used.

Organic centrifuges

These centrifuges theirselves have the capacity high enough, but in case of stoping of one centrifuge (there are two and periodicaly one has to be stoped for checking and greasing), the rate of polymerisation has to be lowered. By equipping the plant with an additional mixed slurry tank of sufficient storage capacity upstream the centrifuges, this problem can be easily solved. The slurry produced in the reactors, which cannot be handled by one centrifuge can be stored in this tank and after operating both centrifuges again, the capacity of the

centrifuges allows to decrease the amount of stored slurry to minimum.

Dryer

To increase the drying capacity is to the opinion of the expert possible only by changing the complete drying system. It should be possible to design a flashing drying system by some Indian engineering organisation. Any necessary equipment can be manufactured in India (blowers, heat exchangers, aluminium or stainless tubes, cooling equipment, flasher).

PP powder transport system

1. It was observed, that often the Nitrogen blower operates with a vacuum on the suction side. The recommendations is to awoid such a situation and to keep always some pressure on the suction side of the blower. The reasons for this recommendation are:

   a) The vacuum will restrict the capacity of the system.

   b) The vacuum creates a possibility of contamination the Nitrogen With the Oxygen in air, and this can cause the bad colour of the final product.

   c) This contamination by Oxygen can create in parts of the transport system an explosive mixture with PP powder.

2. The Nitrogen as a carrier gas in the PP powder transport system has a considerably high temperature, altough cooled on the recycling part. The recommenda-

tion is to lower this temperature by better cooling. The lower temperature of the recycle Nitrogen can help in:

a) increasing the blower capacity and so also the capacity of PP powder transport system.

b) decreasing the possibility of lower quality caused by bad colour of product. The high temperature of unstabilised PP powder in connection with the possible presence of Oxygen, mentioned above, enhances the probability of discolouration of the product.

On the LDPE Plant

The main attention was given the quality problems and how to meet the various costumers specific properties demands.

The IPCL LDPE plant is a tubular reactor, high pressure plant, consisting of two units. As on all tubular reactor high pressure plants it produces a polyethylene polymer with a very broad and flat molecular curve. Such polymer has a very high cristalinity and as a result very good optical properties (haze, clarity). Therefor such polymer is mainly used for film production. But by producing blow-film from such polymer, there should be kept strict conditions - proper cooling (the temperature of film on the first rollers about 60 ^{o}C), correct blowing ratio (the ratio of the diameter of the extruder die to the diameter of the blowed film). If these conditions are not kept (the most important is the blowing ratio), then the film

has a very low tensile strenght in the perpendicular direction to the blow. If the film temperature on the first rollers is too high, the blocking tendency inreases.

The reason of this phenomenons is the relatively high content of low molecular weight fraction ("wax") in the polymer produsedby the tubular process.

This high content of "wax" causes also the lower suitability of such polymer for lamination. The "neck-in" is in such a case higher and the small fluctuation of the "wax" content causes a very high fluctuation of this "neck-in".

By blow molding can the high "wax" content cause the low environtmental stress cracking resistance.

All these difficulties can be partialy improved by producing the polymer with relatively lower density - below 0,920.

The most important improvement can be achieved by decreasing the "wax" content. To decrease the "wax" content it is possible to procede by two different ways:

a) decrease the forming of "wax"

b) improve the removal of the "wax" after the polymerization.

a) <u>Decrease the forming of "wax"</u>

There are following possibilities of minimising the "wax" content:

1. To work at as low temperature in the reactor as possible.

2. To minimise the amplitude of the periodical pressure drop in the reactor.

3. To increase the period between these pressure drops.

All these measures should be realised very carefuly, to avoid the unstabilising of the polymerisation, what can lead to decompositions, or to stop the reaction. It has to be mentioned, that lowering of the reaction temperature leads to decreasing of conversion.

b) Improving the removal of "wax"

There are following ways:

1. Decrease the pressure in the separator
2. Increase the "wax" removal from the system.

It should be mentioned, that the separator pressure decrease leads to the suction pressure decrease of the "hyper" compressor and so to lower production.

These ways of improving the above mentioned and also other specific properties of LDPE in connection of process possiblities were discussed with IPCL menagement and the expert believes, that the discussions held were usefull.

VI. RECOMMENDATIONS ON PBR PLANT

The main problem on PBR plant consists in too frequent screws breskiges of drying extruder and premature wear of the barrel (liners) of this extruder. This reduces the production of the plant.

To prolong the extruder operating life it is recommended:

a) Increase the number of knives on the big extruder (simpliest from 3 to 6), so to eliminate the developing of large lumps, which can caused chocking in the drying extruder hopper. Extruder underfeeding will cause the damage of barrel liners and screws. (Proposed by R. S. Deziel, UNIDO expert for rotating equipment).

b) To shorten the lenght of floating screws and so to lesson the possibility of damaging both-screws and liners. (Proposed of C. S. Patel Polymers Manager). The simpliest way to do it is to put heavy duty bearings just behind the feeding section.

c) To prevent the frequent breaking of the screws, to redesign the above screws in hollow screws. Tube flexibility is an advantage over the solid ones.

d) Divide the "hygrotroll" in four sections and four directions, using the same hydraulic unit. This distribution of pressure to four directions will remove the one direction stress and so it would give a longer life to the above mentioned screws.

I understand, that all these modifications need a very carefull redesign and are quite complicated, but I believe, they are still less expensive than a new equipment.

As to irregularities of the polymeri-sation, it can be only recommended to take full analyses of raw materials by normal running and then by irregular one, and find the reason of not correct reaction by comparising the coming results.

Ivo Hedrna