

The Production of “Diethyl Terephthalate” to replace “Diethyl Phthalate” by using Costing Measures in Iran

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Abstract—Iran is one of the main producers and consumers of plasticizers in the Middle East and Asia, but due to imposed sanctions, unfortunately Iran was deprived from the research and development in this industry. As a result, this has caused continuing the production of harmful plasticizers in Iran. In addition to the destruction and threatening of environment, these plasticizers can also affect the human health.

One of the safe and environmentally friendly plasticizers is “Diethyl Terephthalate” which was recommended by the World Health Organization (WHO), the Food and Drug Administration of the United States of America (FDA) and the European Union (EU).

In this paper, I hope, with accurate reviews of the dimension of the economic, financial and market study of this product, to take a small step in manufacturing and replacing this product with current plasticizers.

Keywords—Plasticizer, Phthalate, Diethyl Terephthalate, Diethyl Phthalate, Industrial engineering, cost measures.

I. INTRODUCTION

DIOETHYL Terephthalate (DOTP) is one of the most widely used plasticizer in PVC industries including medical equipment, car industry, cable and wires, flooring and wall coverings, artificial leather, Toys and Etc.

A. Definition of the problem

DOTP is the main plasticizer of PVC industries in Iran. The institute of epidemiological studies in Germany launched a research about effects of phthalate plasticizers in 1981. At the beginning, this institute tested their assumption on animals and humans. Then found effective and important results, consequently, they have applied very wide constraints on the use of these substances related to the human consumption. With the expansion of researches, European Union (EU) has introduced new rules for the necessary restrictions of the use of phthalate plasticizers even for other industries. Therefore, the producers tried to produce another substance.

Finally in 1986 for the first time, OXEA Company produced DOTP. Compatibility and convenient features of this new product and quite similar application with Diethyl Phthalate (DOP) led to replace it quickly. During this period,

the other plasticizers were also produced, but mainly were not economical for producers and consumers due to higher cost.

Unlike other countries, DOP is still being used in Iran, because new plasticizers are not produced, although, in some cases they are imported.

B. Importance of research

Right now, it seems it is necessary to raise the level of awareness of the community and encouraging manufactures to produce substitute products. It is also necessary to notify and inform widely the factories of plasticizer consumers with a proper planning, so that they will be aware of the risks of using this staff, particularly, they can also cause the gene mutations in human being.

This substances can also have devastating effects on aquatic and terrestrial ecosystems (especially industrial uses), in addition, the continual presence of these substance in water also causes the disrupting the exocrine and the aquatic.

C. Research purposes

Since Iran is one of the leading countries in petrochemical industry, we intend to use the potential of existing equipment, as well as accessing required raw materials and use of large manufacturing plants facilities (such as petrochemical plants) and small ones (such as production unit) to examine producing DOTP and replace it with DOP.

D. Literature review

In recent years, extensive research has been done in this field, for example, the effects of DOTP were studied on humans for the first time in 1976. In an experiment, the amount of this substance was measured in human platelets.

By the passing time and increasing use of phthalate, in the next phase, the extensive testing was carried out on laboratory animals like Mice. For example, the effects of phthalates on mice liver were studied.

Medical Center of G. Washington University carried out the similar and complimentary study and experiments with some changes in the structure of DOP on mice liver.

BASF Company in Germany also studied inhalation toxicity of phthalates on the fertility of women.

Researchers of the University of Messina in Italy provided the harmful effects of phthalates during pregnancy and the milking mothers as well as the infants.

The researchers of the Toulouse University, France, studied the exposure of the human body to the phthalate and its effect on the adult livers. They employed the potential mechanism of toxicology by using biology system.

E. Questions and research hypotheses

- Why green plasticizers such as DOTP have not been produced in Iran?
- What is the importance of producing DOTP in Iran?
- What are the requirements for producing DOTP in Iran?
- What are the restrictions for implementing this plan in small businesses?
- Which industries have been able to allocate the largest sector of the market of plasticizer consumption?

II. RESEARCH METHODOLOGY

A. *Using information and available evidence*

Many discussions and Technical studies about DOTP are available by various European companies. In Iran, the first and only producer of DOTP is the Fiber Intermediate Product Company (FIPCO) that was provided the information.

In other case for the first time, Farabi Petrochemical in order adaptation to modern science, switched one of the producing line of DOP to DOTP in 20,000 t/y capacity.

The following points were obtained by reviewing the information of FIPCO company:

Annual Costs

TABLE I

ANNUAL COST OF PROJECT

Annual Costs			Fixed Cost		Variable Cost	
No.	Description	Annual Cost (USD)	Percent	Value (USD)	Percent	Value (USD)
1	Raw Material	24,500,000	0.0	0	1.0	24,500,000
2	Salary Cost	217,000	0.7	151,900	0.3	65,100
3	Maintenance Cost	249,000	0.2	49,800	0.8	199,200
4	Amortization Cost	396,000	1.0	396,000	0.0	0
5	Insurance Cost	13,050	1.0	13,050	0.0	0
6	Marketing & Sales Costs	35,000	0.0	0	1.0	35,000
7	Bank Interest	730,000	1.0	730,000	0.0	0
8	Energy, Tel, Internet Costs	131,600	0.2	26,320	0.8	105,280
9	5% for the unforeseen	1,313,582	0.5	656,791	0.5	656,791
Total Annual Costs		27,585,233	-	2,023,861	-	25,561,371

Calculation of the Working capital

TABLE II

WORKING CAPITAL OF PROJECT

No.	Description	Annual Costs (USD)	Period (Month)	Price (USD)
1	Raw Material	24,500,000	1	2,041,666
2	Energy, Tel, Internet Costs	131,600	1	10,966
3	Maintenance Cost	249,000	1	20,750
4	Salary Cost	217,000	1	18,083
Total Working Capital Requirement			1	2,091,465

Total value of the project

TABLE III

VALUE OF THE PROJECT

No.	Description	Total (USD)
1	Fixed Investment	4,352,400
2	Working Capital	2,091,465
Total Investment		6,443,865

Calculation of the financial ratios

Calculation of the breakeven point

Percentage of Capacity in Breakeven Point =

$$\frac{\text{Annual Fixed Costs}}{\text{Total Sale} - \text{Variable Costs}} \times 100 \quad (1)$$

$$= \frac{2,023,861}{30,840,000 - 25,561,371} \times 100 = 0.38$$

This plan is reached to the breakeven point, on 38% of capacity, while the production cost is equal with the income from the sale. It means this project is a good economical plan.

Covering of the most required costs by existing equipment is one of the reasons for low breakeven in development plans.

Calculation of the annual benefit

Benefit and loss (special benefit)

$$\text{Special Benefit} = \text{Total sales} - \text{total production Costs} \quad (2)$$

$$= 30,840,000 - 27,585,233 = 3,254,767 \text{ (USD)}$$

Calculation of the internal rate of return (IRR):

$$\frac{\text{Annual benefit} + \text{Financial Facility Cost}}{\text{Total Investment}} \times 100 \quad (3)$$

$$\frac{3,254,767 + 730,000}{6,443,865} = 0.62 \%$$

Return Period of the investment

$$\text{Return period of investment} = \frac{1}{IRR} = \frac{1}{0.62} = 19 \text{ Months} \quad (4)$$

* Return period of investment has been calculated on nominal capacity.

B. Questionnaire

Considering this point that we are in the market studies phase and are not aware of the nature and character of potential consumers, we decided to prepare a "Questionnaire" about needs, opinions and shortages of consumers:

Fig 1.questionnaire
In The Name of GOD

"Questionnaire Levels of Consumer Satisfaction"

Company Name:

Type Of Product:

Company Address:

Email:

Website:

Phone/Fax:

No.	Index	Importance (0 – 20)	Description- Suggestion
1	Purity		
2	Volatility		
3	% Water		
4	Consumption Factor		
5	Electrical Resistance		
6	Mechanical Strength		
7	Health Effect		
8	Appearance Such as Odor, Color, Etc		
9	Ease of Access		
10	Price		
11	Traction Market		
12	Costumer Satisfaction		
13	End User Needs		

C. Method of data validation

The most important issue of sampling validity is that whether society and individuals condition have been discussed or not? Whether measuring instrument which was introduced in the study attributes adequately?

III. RESULTS

In this study we discussed introducing the plasticizers, its role in world's industry, checking the status of existing tendency of manufacturers to use phthalate plasticizers, guidance, obstacles and preparing the model to solve the problem. Up to the individuals associated with this study, we take next steps to implement it with a full view.

A. Research result

Results of this paper will respond many ambiguities and questions that may arise for expert, some of them including the followings:

- Complete understanding of the laws about the use of plasticizers in the world
- The benefit of structural reforms in production for manufactures

- The social effects of using the green plasticizers such as DOTP
- Feasibility study of DOTP to replace DOP
- The benefit of the producing green plasticizer
- Supporting producers for the legislators such as Standard
- Improving product quality

B. Research innovation

This paper which is based on my Master's Thesis, was expended to produce DOTP in Iran for the first time. All of the information in this thesis has been prepared from experimental and field research.

C. Suggest for future research

Providing the description of this thesis and the field research, I suggested the following cases to researchers for research and development:

- Replacing DOTP in producing of the finish product
- Effect of DOTP on human health
- Feasibility study of DOTP in production units
- Limitation of the DOPT production and ways for resolving them in Iran

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