BIBLIOGRAPHIC DATA SHEET	1. CONTROL NUMBER	2. SUBJECT CLASSIFICATION (695)
	PN-AAH-995	DM00-0000-G698

3. TITLE AND SUBTITLE (240)

Prefeasibility study for production of plastic pipe and fittings in Jordan; phase II report

4. PERSONAL AUTHORS (100)

5. CORPORATE AUTHORS (101)

Swindell-Dressler Co.

6. DOCUMENT DATE (110)	7. NUMBER OF PAGES (120)	8. ARC NUMBER (170)
1975	25p.	J0668.49.S978

9. REFERENCE ORGANIZATION (130)

SDC

10. SUPPLEMENTARY NOTES (500)

(Study conducted for the National Planning Council, Hashemite Kingdom of Jordan)

11. ABSTRACT (950)

12. DESCRIPTORS (920)

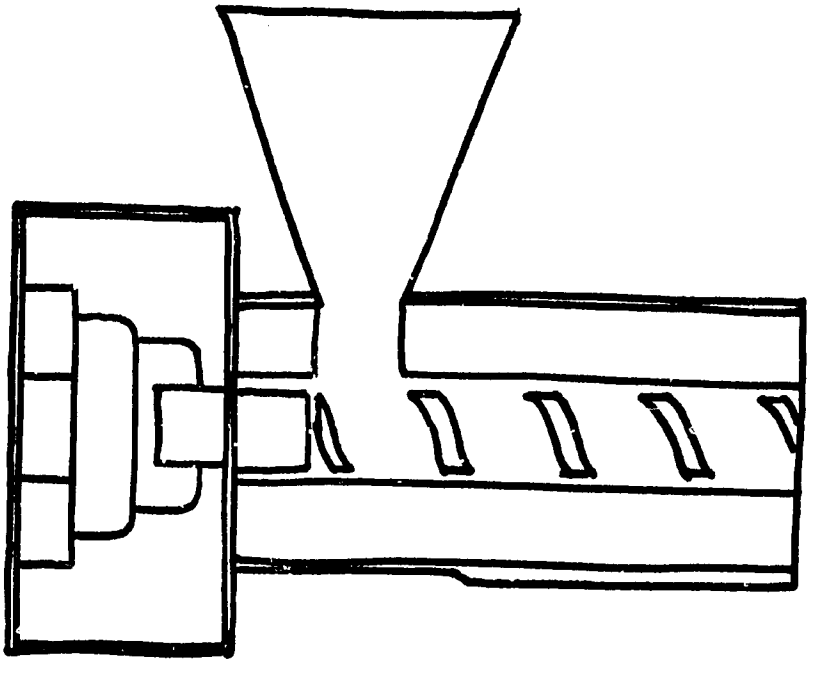
Jordan
Manufacturing
Feasibility
Plastic pipes
Pipes
Industrial plants
Plastics industry
Cost analysis

13. PROJECT NUMBER (150)	
14. CONTRACT NO.(140) Jordan	15. CONTRACT TYPE (140)
16. TYPE OF DOCUMENT (160)	

41

AID 590-7 (10-79)

DRAFT
PHASE II REPORT
PREFEASIBILITY STUDY
FOR
PRODUCTION OF PLASTIC PIPE
IN JORDAN



Swindell-Dressler Company
A Division of Pullman Incorporated
441 Smithfield Street
Pittsburgh, Pa., U.S.A.

JANUARY 1975

D R A F T

Phase II Report

PREFEASIBILITY STUDY

For

Production of Plastic Pipe and Fittings

In

Jordan

Submitted To

The Hashemite Kingdom of Jordan

Represented By

The National Planning Council

Swindell-Dressler Company
A Division of Pullman Incorporated
441 Smithfield Street
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January 1975

CONTENTS

SUMMARY

A survey of existing Jordanian industry indicated some good facilities available for the manufacture of plastic pipe. There is one new plant with an existing capacity of 2000 mt per year which can be expanded to produce 5000 tons annually. There are other factories in Jordan with a potential to produce several hundred tons of pipe, conduit and fittings each year.

There are also sizable capabilities in other middle Eastern countries; Lebanon and Saudi Arabia alone having capacities totaling more than 14,000 mt per year. It is likely that more facilities will be built in the area following the erection of large petrochemical complexes in Egypt and Saudi Arabia.

The high costs of new pipe manufacturing machinery are shown. It is recommended that no new facilities be erected for the production of plastic pipe or pipe fittings because the existing capacities in both Jordan and neighboring countries are expected to remain greater than the market demand for some time.

ACKNOWLEDGMENTS

The Contractor's personnel who have been involved in this study deeply appreciate the cooperation received throughout the progress of the work. Their gratitude goes specifically to the officials and other personnel of The Ministry of National Economy; The National Planning Council; The Jordan Centre for Industrial Development; The Natural Resources Authority; The Jordan Housing Corporation; The Department of Statistics; and US - AID in Jordan and Washington, D. C.

Individual acknowledgment should go to a number of people in all of the above mentioned groups but space will not permit the listing of such a large number. The Contractor does, however, wish to thank the Committee of the National Planning Council as a body and as individuals for their devoted service in supplying information, guidance, and criticism at all stages of the work.

ABBREVIATIONS

MNE	The Ministry of National Economy
NPC	The National Planning Council (formerly the Jordan Development Board)
NRA	The Natural Resources Authority
MRD	The Mineral Resources Division (of NRA)
JCID	The Jordan Centre for Industrial Development
JHC	The Jordan Housing Corporation
UNIDO	United Nations Industrial Development Organization
JD	Jordanian Dinar
GOJ	Government of Jordan
USA	United States of America
SDC	The Swindell-Dressler Company

INTRODUCTION

The National Planning Council was established by provisional law No. 68 of November 25, 1971 to replace the Jordan Development Board. According to this law, NPC is responsible for the preparation and formation of long and short-term comprehensive well integrated plans and cooperation with the Budget Department in setting up priorities among the selected development projects for implementation in the GOJ budget. The NPC is responsible for manpower planning, following the implementation of development projects, obtaining loans for financing the execution of projects, and the creation of planning cells in the various ministries.

Pursuant to this responsibility, the National Planning Council contracted with the Swindell-Dressler Company, a Division of Pullman Incorporated of Pittsburgh, Pennsylvania, U.S.A., hereinafter termed the "Contractor" to conduct a study of the feasibility of manufacturing products of glass and certain building materials and components in Jordan, for both national consumption and for export. Swindell-Dressler subcontracted with the Agri Division of Dunlap and Associates, Inc., Manhattan, Kansas, U.S.A., for assistance on the marketing and pricing aspects of this project.

A Phase I report, "Prefeasibility Study for Glass, Building Material and Components Industry" was submitted to NPC in August 1972. Among other items this report recommended that the production of plastic pipe, in diameters from 38 mm (1-1/2") to 200 mm (8"), and fittings be considered during the Phase II investigation.

Note: This study and report covers the use of plastics only for the manufacture of pipe and fittings.

DEFINITIONS

A plastic may be defined as a material that contains as an essential ingredient an organic substance of large molecular weight and at some stage of manufacture can be shaped by flow.

The term resin is usually applied to the principal material, generally a high polymer, in the plastic product. Fillers such as wood flour are added to improve the properties of the end product. Extenders are added mainly to cheapen the cost. Plasticizers are added to improve the properties such as the flexibility. Thermosetting plastics are those which become permanently hard when heated above a certain temperature. Thermoplastic materials are those which soften upon heating and harden when cooled.

I. RAW MATERIALS

Polyvinyl chloride (PVC) is the raw material most commonly used for the manufacture of plastic pipe. Polyvinyl dichloride (PVDC), polyethylene, polypropylene and acrylonitrile-butadiene-styrene (ABS) resins are also used in varying amounts in the production of plastic pipe.

PVC

The average PVC pipe will withstand a service temperature of 160°F (71°C). Pipes are made of unplasticized resin and are known as rigid PVC while flexible PVC is used to coat electrical cable and wire. PVC ingredients can be compounded so that the finished material is relatively fire resistant and self extinguishing.

PVDC

This material is similar to PVC in properties except that it will withstand a service temperature of approximately 180°F (82°C). PVDC is self extinguishing.

Polyethylene

Polyethylene has outstanding chemical resistance and is flexible down to very low temperatures. The service temperature of 120°F (49°C) is somewhat lower than that of the other materials.

Polypropylene

This material has a higher melting point, compressive strength and flexural strength and is therefore preferred over polyethylene for hot water pipes. The service temperature is rated up to 180°F (82°C).

ABS

Products made from ABS are rigid but have high impact resistance down to temperatures as low as -40°F (-40°C). The maximum service temperature is 180°F (82°C).

The basic chemical substances for producing the plastic resins are derived from coal, petroleum or natural gas. The choice depends largely upon the availability in each case.

As stated earlier PVC is the most widely used raw material in plastic pipe manufacture. In the U.S.A. the raw materials are used as follows in descending order:

PVC and PVDC
ABS and Polypropylene
Polyethylene

The quantity of PVC and PVDC consumed is roughly twice that of the other two categories combined. The prices of plastic raw materials vary widely according to quantities purchased and additives such as colors or reinforcements or fibres. The relative costs of the five materials are generally as follows, in order of increasing cost:

PVC
Polyethylene
Polypropylene
ABS
PVDC

The majority of the material lost by trimming extruded pipe to standard lengths and the extra raw material (up to 50%) used in the sprues and runners during injection molding can be ground and reused if it is kept free of foreign materials, especially metal.

None of the basic raw materials such as PVC are now produced in the Middle East, but plans call for a $1,000,000,000 petrochemical complex in Egypt and a somewhat smaller facility in Iran. However, the moulding materials, basic resins blended with plasticizers and other additives, are produced in a number of factories in the Middle East. The basic resins are supplied from Europe, Asia and North America.

II. MANUFACTURING PROCESSES & HAZARDS

A. Manufacturing Processes

All of the standard sizes of plastic pipe are made by the dry hot extrusion process, while small quantities of special sizes and shapes used for applications such as heating and ventilating hoods and ducts are made by building up alternate layers of plastic sheet and reinforcing materials such as glass fibres.

In the dry hot extrusion process the thermoplastic molding material is fed into a hot cylinder. After being softened by the heat the material is forced by one or more spiral screws through the cylinder and out through a die orifice whose shape and size determines the cross section of the pipe. The pipe is carried from the die through an air or water-cooled bath to harden it.

The pipe fittings, consisting of items such as elbows, tees, couplings and adapters, may be formed by injection molding, blow molding or by fabricating. The injection molding machine consists of a split cavity, containing the necessary cores, into which heated raw material is forced by a ram or rotating screw. After the material has cooled and hardened sufficiently the cavity is opened and the work piece removed. Some low pressure fittings are made by the blow molding process in order to reduce mold costs. Plastic pipe fittings can be cut in sections from the pipe and joined into the final shape by either cementing or welding.

B. Manufacturing Hazards

Hazards to health during the manufacturing process result mainly from the use of acids, solvents and plasticizers which may cause injury to personnel from contact or inhalation.

III - APPLICATIONS

A. Uses

Pipes and fittings made of the various materials have the following uses:

PVC

This material has been used for pipe for more than 35 years and is currently used in most of the rural water distribution systems and underground irrigation piping projects in the U.S.A. Due to its high chemical resistance it is used in a wide variety of chemical industries including transportation of mineral oils. In recent years more than half of the sanitary drainage lines in Europe have used PVC pipe.

PVDC

PVDC has applications similar to those of PVC but its higher service temperature offers a somewhat wider latitude of usage.

Polyethylene

This material is used for natural gas distribution systems, water systems and some corrosive chemicals. Polyethylene for piping is made in a number of densities, the highest density having the highest strengths and temperature and chemical resistances.

Polypropylene

Because of the flexibility and smooth surface of pipes made of polypropylene it is frequently possible to pull them through old metal pipes or walls when buildings are being remodeled.

Acrylonitrile-Butadiene-Styrene

ABS is used in hot water lines, residential drain waste and vent systems, and sewage treatment plants.

B. Advantages of Plastic Pipe

Light weight. Easy to handle and install.

Resistant to corrosion by water and a wide range of chemicals.

Flexible. Aids in installation.

Smooth surfaces, inside and outside. Prevents wax build up in oil lines and reduces resistance to flow for all materials.

Low thermal conductivity. Reduces heat loss from material being transported.

Electrically nonconductive. Not effected by electrolysis so the buried pipe is not damaged by destructive ground currents.

Gas-tight and water-tight joints of electrical conduits add to the safety.

C. Disadvantages of Plastic Pipe

Electrical nonconductivity. This can be a disadvantage in conduits because it results in the need for a separate grounding system.

High thermal expansion requires special joints when connections are made to metal pipes.

Mechanically weak when compared to metals. There are limitations to service temperature and pressure. If not adequately supported the pipe may sag and form pockets.

Flammability. While many plastics are self extinguishing, there is some fire hazard. There is also some health hazard from fumes generated during the burning of plastic pipe.

IV. EXISTING FACILITIES IN JORDAN

The following Jordanian firms are in the business of manufacturing plastic pipe:

A. Arab Plast Company
Marka

This company recently moved into a new factory building in Marka which has a floor area of 1800 m^2. Their old plant had an annual capacity of 500 mt while the equipment in the new location can produce 2000 mt per year. The new facility can be expanded to manufacture 5000 mt annually.

The Arab Plast has the following equipment:

3 extruders one of which can make pipe up to 8 inch diameter. The plant currently has dies to produce only up to 3 inch diameter. They have authorization to import 8-inch dies and the proprietor states he could have them in two months if orders were received.

1 injection molding machine with 300 gram capacity.

1 blow molding machine that can form a 30-Liter water can.

1 film machine (extruder-blower)

The main product lines of this company are:

1. Electrical Conduit. Diameter range from 11 to 29 mm and some is exported. They plan to manufacture boxes and fittings for these conduits.

2. Electric Wire Coating. Export coated wire.

3. Pipes. See note above under equipment.

4. Hoses. These are flexible and used for watering of gardens and lawns.

5. Plastic Strips. These are used for chairs.

6. Industrial Profiles. These cover a wide variety of mouldings.

7. Rolling Window Shutters.

8. Household Articles. These include cups and plates.

9. Film. The film is formed into bags.

B. Jordan Plastics Co.
Naur Road

This is another large, clean, well-lighted plant, however their pipe manufacturing facilities are in Bethlehem. This firm stated that they could ship plastic pipe up to 4 inch diameter to the east bank if market demand should develop. The equipment can make up to 10 inch diameter pipe if dies were obtained.

B. Jordan Plastics Co. - (Continued)

The plant on Naur Road manufactures injection molded novelties and polyurethane foam furniture padding. The production scheme for the foam was conceived by the firm and the equipment is largely of local manufacture.

The manager stated that he could, if sales required, be in production of pipe in Naur within four months.

C. Petra Plastics Co.
Near Sports City

Petra Plastics Co. produces a wide variety of injection molded products as well as film up to 70 cm wide. The plant is provided with two injection molding machines each with 350 grams capacity, two extrude - blow machines for film and one extruder that can produce pipe up to 1-1/2 inch diameter.

The manager stated that considerable study was done abroad concerning the manufacture of larger sizes of pipe but no equipment was purchased because of low sales demand.

V. MANUFACTURERS IN OTHER MIDDLE EASTERN NATIONS

Neighboring Middle Eastern nations have the following facilities for the manufacture of plastic pipe.

A. Saudi Arabia

Saudi Arabian Plastic Products Co. (SAPPCO)
Riyadh

This is a very large new factory which was built with an initial capacity of 3,000 mt per year but later enlarged to 6,000 mt. The plant design provides for an ultimate expansion to 16,000 mt. The original equipment could form 12-inch diameter pipe but the management plans to acquire equipment to produce pipe up to 24 inches in diameter. This company also plans to manufacture foamed urethane insulation panels.

Nepro Plastics Co.
Jeddah

This is a much smaller firm than SAPPCO. It was equipped with Japanese machinery.

B. Lebanon

The following firms produce plastic pipe in Lebanon:

Eternit Company

Babikian & Fils

United Lebanese Industries

Eastern Plastic Works (Siblini Bros.)

Plastic Form (Kanjau & Co.)

B. Lebanon - (Continued)

These firms have an annual manufacturing capacity of approximately 8,000 mt and are currently producing at the rate of about 5,000 tons per year. The largest pipe being made is 6 inches in diameter although equipment is available to product 10 inch pipe. Fittings are being produced by the injection moulding process. It is estimated that Lebanon is exporting about 40% of their total production of plastic pipe and fittings. Both polyvinyl chloride and high density polyethylene materials are used.

C. Bahrain

Gulf Plastic Industries
Bahrain

This company produces both electrical conduit and water pipes. They also make a wide variety of injection molded ware including soft drink bottle cases, jerry cans, kitchen and tableware and decorative ceiling tiles.

D. Dubai

Ahmad Majed Al-Ghurrair & Sons
Dubai

This is a relatively small production facility. The firm also produces aluminum roof gutters.

VI. ESTIMATED MARKET DEMAND

The National Planning Council supplied the following estimates of anticipated consumption for plastic pipe and fittings:

Category	mt/year
Present Uses	1,500
To subsitute for metal pipe	1,000
Irrigation	600
New Industries	1,000
Fittings (Local & Export)	1,500
Expected Pipe Exports	1,000
Total	6,600

VII. NEW EQUIPMENT COSTS

A. Extrusion Equipment for Pipes

One good quality extruder, with the appropriate dies can form all of the sizes of pipe specified. These include 38 mm (1-1/2"), 50 mm (2"), 100 mm (4") and 200 mm (8") diameters.

The current price (C & F Beirut) for the extruder, dies, haul-off device, cut-off saw and scrap grinder is JD 63,300.

B. Injection Molding Equipment for Pipe Fittings

The manufacture of fittings for pipe from 38 mm (1-1/2") through 200 mm (8") diameter would require two injection molding machines. Sizes up to 150 mm (6") can be formed on a 375-ton machine while the 200 mm (8") fittings would require a 700-ton press.

Current prices for the necessary equipment are:

1 375-ton expanded-platen plastics injection molding machine complete with chiller, spare parts and all controls but without molds---------- JD 64,900

1 700-ton wide-platen plastics injection molding machine complete with chiller, spare parts and all controls but without molds---------- JD 93,300

1 Scrap grinder with throat to accept 8" tee---------- JD 6,900

B. Injection Molding Equipment for Pipe Fittings - (Continued)

1 Lot of molds estimated as follows:

COST - JD

Size-Inch	Tee	90° E11	45° E11	Connector
1-1/2*	5,500	4,400	4,200	4,200
2 *	6,900	5,500	5,200	5,200
4	6,000	4,900	4,700	4,700
6	6,900	5,500	5,200	5,200
8	8,600	6,900	6,600	6,600
	33,900	27,200	25,900	25,900

*The molds for 1-1/2" and 2" are 4-cavity while all the other sizes are single-cavity.

SUMMARY

Tee	33,900
E11	27,200
Connector	25,900
Adaptor	25,900
JD	112,900

It should be noted that all of the estimated costs shown in this report are for equipment and molds and dies C & F Beirut. It should also be noted that the mold costs provide for only four of the most commonly used shapes whereas there will be some demand for Y-branches, reducers, adaptors, caps, traps and expansion joints.

1. Injection Molding Equipment for Pipe Fittings - (Continued)

TOTAL EQUIPMENT COSTS - INJECTION MOLDING

	JD
375-ton machine	64,900
700-ton machine	93,300
Scrap grinder	6,900
Molds	112,900
TOTAL	278,000

. Miscellaneous Costs

No costs have been included for buildings, foundations, electrical wiring, installation labor and materials, or commissioning technician.

These prices were supplied by the Cincinnati-Milacron Corporation which is one of the largest manufacturers of plastic pipe production equipment in the world. The machinery could be supplied from Austria, or from the U.S.A.

VIII. DISCUSSION AND RECOMMENDATIONS

Pipe

Since the Phase I report was submitted on this project the new plastic pipe production facility of the Arab Plast Company has been completed and put into operation. The present capacity (2000 mt per year) of this new plant is underutilized and the ultimate output (5000 tons) can take care of the market demand that is expected to develop within the next few years. When the demand increases to the point that Arab Plast can not meet it with their expanded facilities it seems very likely that they will erect new buildings and machinery and that other firms such as Jordan Plastics Co. and Petra Plastics Co. will also add to their capacities.

The Contractor does not believe that the Jordanian plastics firms can expect to develop a very large long-range export market because there are sizable plants in the Middle East that are underutilized and are seeking new export business. After the erection of the large petrochemical complexes in Egypt and Iran, it is expected that additional plastic pipe plants will be built in the area. This is based upon the increased availability of raw materials and a higher market demand due to greater industrial consumption of plastic pipe. The existence of these new factories would reduce even further the opportunities for Jordan or other nations to do very much exporting.

Because existing plastic pipe manufacturing facilities in both Jordan and neighboring countries are expected to be underutilized for some time and because additional new plants are expected to be built in other nations, it is recommended that no expansion of present facilities be considered at this time.

B. Fittings

Regarding the manufacture and export of fittings it should be noted from Chapter VII, that the cost of molds to produce these fittings is quite large. Furthermore, the manufacture of fittings, especially for high pressure applications, to meet international standards is a demanding operation requiring considerable expertise and first class materials.

The production of plastic pipe fittings is a highly specialized industry in most parts of the world. Although the SAPPCO plant in Saudi Arabia is a rather large facility by world standards and it makes pipe for high pressure water lines, it does not plan the production of any fittings. While SAPPCO may not make high pressure fittings in the future, the Contractor believes that within a few years that firm will be producing low pressure fittings and thereby reduce opportunities for other nations to export those items to Saudi Arabia.

In the U.S.A. there are approximately 100 manufacturers of plastic pipe but there are only four large producers of fittings and about ten more smaller makers of fittings. It is obvious that the large capital and maintenance costs for molds require a sizeable market to recover these costs and earn a reasonable profit.

The Contractor therefore recommends that high pressure pipe fittings not be producted in Jordan. It is, however, recommended that any of the existing companies, who have the necessary equipment, be encouraged to make low pressure fittings for drain and vent lines.