No.

昭和56年度中近東アフリカ計画に基づく石油化学工業(準高)集団研修コース(No.84)

実施報告書

昭和57年3月

国際協力事業団
研修事業部

はじめに

石油化学工業研修コースは，日本政府の開発途上国に対する技術協力事業の一環として，石油化学工業協会をはじめとする石油化学工業関連企業各社の協力の下に，昭和５０年よりこれまで通算７回実施されて来ました。

研修参加者は，中近東・アフリカの主に産油国の石油化学工業分野に於いて実際に関連業務に従事する中堅・上級技術者，石油化学工業開発プロジェクト関係者，石油化学工業関連政策立案者，等であります。

これら中近東・アフリカ諸国から我国に寄せられる技術協力に対する要望は強く，本コースもそれに応えるべく開設されているものですが，同時にこれらの国々との友好協力関係の強化にも，重要な役割を果たしてきたものと確信いたします。

今般本コースの実施概要報告にあたり，多大のご協力を賜りました関係各位に厚くお礼申し上げるとともに，今後ともご支援とご協力を賜りますようお願い申し上げます。

昭和５７年３月

国際協力事業団
研修事業部長　山村　寛

目　　次

1. 昭和５６年度実施状況報告

1）研 修 期 間

昭和５７年１月２８日～昭和５７年３月１２日

2）研修日程概要

実　施　概　要	日　数
1. ＪＩＣＡブリーフィング	0.5
2. ＪＩＣＡ一般オリエンテーション	4.5
3. 専門講義	12.5
4. 関連工場見学（東京周辺）	3.0
5. 関連工場見学（中部・関西地方）	4.5
6. 顔合せ懇談会・技術討論会	1.0
7. カントリーレポート	0.5
8. 評価会・閉講式	0.5
計	27.0

研修員は新宿のホテルに宿泊する一方，当事業団実施の来日時ブリーフィング及び一般オリエンテーション（日本の文化・社会，経済一般）を受けた後，別添の研修日程に沿って「東京インターナショナル・センター（ＴＩＣ）」において専門講義に参加した。その間，石油化学工業関連施設を見学した。研修期間中の不明点等の解消を目的として中間期に，講師陣と全研修員との質疑応答を行った。又，研修評価会には講師陣も加わった。

研修を終了するにあたり３月１０日（水）ＴＩＣにて閉講式を行ない，当事業団関係者はじめ通産省，石油化学工業協会の関係各位並びに講師の方々の出席の下に，研修員全員に修了証書を授与した。

3） 研修員応募概要

(1) 参加研修員（１１名）の国籍，年令，現職等

別添資料の通り。

(2) 別表の通り，定員１２名，割当１５ヵ国１７名に対して１５名の応募者があったが，サウジアラビアは割当枠２名をオーバーしたため最若年者１名を，定員１２名を締め切った後に書類が到着したシリヤ２名をそれぞれ得むなく落した。

一方，来日の時点でバハレーンの１名は，バハレーンの国内事情で来日不能となり，計１１名で研修は実施された。

(3) 過去７回の受入実績

年度	50		51		52		53	
定員	12		12		12		12	
期間	11. 6～12.20		11. 4～12.18		3.16～ 4.29		3. 1～ 4.14	
割当国＼割当／実績	割当	実績	割当	実績	割当	実績	割当	実績
アルジェリア	0	0	1	0	1	1	1	1
エジプト	2	1	2	1	1	2	1	1
イラン	0	0	2	3	2	2	2	0
イラク	3	1	2	0	2	2	2	2
クウェート	2	2	2	1	2	1	2	1
リビア	3	2	2	0	2	1	2	1
オマン	0	0	1	0	1	0	1	0
カタール	0	0	1	0	1	0	1	0
サウジアラビア	3	0	2	1	2	2	2	0
スーダン	0	0	0	0	1	1	1	1
トルコ	0	0	0	0	1	1	1	0
アラブ首長国連邦	1	0	1	0	1	0	1	1
計	14	6	16	6	17	13	17	8

年　　度	54		55		56		57（予定）
定　　員	12		12		12		12
期　　間	2.28〜4.12		2.26〜4.10		1.28〜3.12		1.27〜3.11
割当国＼割当／実績	割当	実績	割当	実績	割当	実績	割当
アルジェリア	1	1	1	1	1	1	1
バハレーン	1	0	0	0	1	0	0
エジプト	0	0	1	0	1	1	1
イラン	2	1	2	0	0	0	0
イラク	2	0	2	0	2	1	1
ジョルダン	0	0	1	1	1	1	1
クウェート	2	0	1	1	1	1	1
リビア	1	0	2	0	1	0	1
レバノン	0	0	1	1	1	1	1
モロッコ	0	0	1	1	1	1	1
オマン	0	0	1	0	1	0	1
カタール	2	1	1	0	1	1	1
サウジアラビア	2	0	2	1	2	2	1
スーダン	1	1	1	1	1	1	1
シリア	0	0	1	1	1	0	1
アラブ首長国連邦	2	1	1	0	1	0	1
トルコ	1	1	1	0	0	0	0
ヴェネズエラ	0	0	0	1	0	0	1
計	17	6	20	9	17	11	15

4） 研修実施協力機関

(1) 政府機関および関連団体

通商産業省　通商政策局技術協力課

〃　　　基礎産業局基礎化学品課

（財）　　造水促進センター

(2) 民間団体

石油化学工業協会

(3) 民間協力企業

日揮㈱，三井東圧化学㈱，三菱油化㈱，東レ㈱，三井石油化学工業㈱，住友化学工業㈱，旭化成工業㈱，日本合成ゴム㈱，旭ダウ㈱，日本石油化学㈱，三菱化成工業㈱，日本触媒化学工業㈱，積水化学工業㈱，積水化成品工業㈱，松下電器産業㈱，トヨタ自動車工業㈱，ブリヂストン・タイヤ㈱，千代田化工建設㈱，ライオン㈱，旭硝子㈱，石川島播磨重工業㈱

5）添 付 資 料

(1) 研修日程表

月 日	曜	後
1／28	木	
29	金	
30	土	
31	日	
2／ 1	月	
2	火	
3	水	
4	木	
5	金	全　講　師
6	土	
7	日	
8	月	平　川　芳　春
9	火	市　東　正　利
10	水	武　藤　伸次郎
11	木	
12	金	施設　見学
13	土	
14	日	
15	月	大　橋　俊　英

5）添 付 資 料

(1) 研修日程表

月日	曜	午　　　前		午　　　後	
1／28	木	来　日			
29	金	ブリーフィング			
30	土				
31	日				
2／ 1	月	オリエンテーション		〃	
2	火	〃		〃	
3	水	〃		〃	
4	木	〃		〃	
5	金	〃		顔合せ懇親会	全　講　師
6	土				
7	日				
8	月	総　論	平　川　芳　春	総　論	平　川　芳　春
9	火	日本の石油化学	灰　谷　佳　朗	カントリーレポート	市　東　正　利
10	水	設立基盤（流通，インフラ）	椿　　誠	設立基盤（政府・教育関係）	武　藤　伸次郎
11	木	祭　　日			
12	金	建設と管理	芝　尾　紘　一	造水促進センター，茅ガ崎海水淡水化施設　見学	
13	土				
14	日				
15	月	オレフィン・BTX	跡　部　輝　彦	LDPE	大　橋　俊　英

月日	曜	午前		午後	
2/16	火	電　解	斉　藤　　修	P P	木　口　智　司
17	水	住友化学工業　千葉工場　見学			
18	木	アンモニア	斉　藤　修　郎	メタノール	江　口　知　己
19	金	SM・PS	登　原　明　史	塩ビ（ポリマー，モノマー）	上　尾　敬　三
20	土				
21	日				
22	月	ブタジエン・合成ゴム	寺　西　　丕	ブリヂストン・タイヤ　東京工場　見学	
23	火	HDPE	片　岡　俊　樹	ED・EG	平　井　満　夫
24	水	洗　剤	奥　村　　統	技術討論会	
25	木	メインテナンス	高　岩　和　雄	環境問題	上　尾　敬　三
26	金	保　安	川　副　正　人	計画と立案	鈴　木　竜　之
27	土				
28	日				
3/ 1	～3/6	関西方面研修旅行　3/1午前　TPA，DMT，合成繊維　於　東レ三島工場			土　屋　泰　昭
7	日				
8	月	世界の石油化学	日　下　芳　春	日本の役割	髙　橋　克　行
9	火	日揮　横浜工場　見学		石川島播磨重工業　横浜工場　見学	
10	水	レポート提出		エヴァリュエーション・ミーティング	16:00　閉講式
11	木	帰国準備			
12	金	最終帰国日			

(2) 参加研修員リスト

PARTICIPANTS

TRAINING COURSE IN PETROCHEMICAL INDUSTRY FOR MIDDLE EAST COUNTRIES

FISCAL YEAR 1981

ALGERIA  Mr. Abdelhamid BENIDDIR Chief Engineer, SONATRACH Home: 11 Rue Alexandre Ribot, Alger, Algeria		EGYPT  Dr. Ahmad Mostafa DESSOUKI Petrochemical Advisor, Egyptian General Petroleum Corporation Home: 331 Ramses Street, Cairo, Egypt
IRAQ  Mr. Ali Husain HNOOSH Manager, Engineering Dept., State Enterprise for Petrochemical Ind. Home: Petro Houding Khaliliah Basrah, Iraq	JORDAN  Miss Suhair AMAWI Chemical Engineer Ministry of Industry and Trade Home: P.O. Box 926149 Amman, Jordan	KUWAIT  Mr. Sami Mohamed AL-MEER Chemical Engineer Ministry of Oil, Technical Affairs Home: P.O. Box. #4926 Safat, Kuwait
LEBANON  Mr. Ahmad Mohammad RAAD Head of Textile Department Ministry of Oil and Industry Home: Ras El-Ain Street, Baalbek, Lebanon	MOROCCO  Mr. Zdazi HAMID Engineer in Charge of Refining Service, Ministry of Energy & Mines Home: Rue 228, Croupe 5, #43, Kenitra, Morocco	QATAR  Mr. Mahmoud Abdel Rahman MUFTA Petrochemical Investigator Refining and Industry Qatar Petroleum Corporation
SAUDI ARABIA  Mr. Mohammed RAYES Industrial Technology Department, SABIC Home: P.O. Box 5101 SABIC Riyadh, Saudi Arabia	SAUDI ARABIA  Mr. Hamad AL-OLAYAN Research Assistant, SABIC Home: P.O. Box 15391 Riyadh, Saudi Arabia	SUDAN  Mr. Mohammed Ahmed Mohammed EL-HAG Head Lub Oil Technical Unit, Juba Branch, General Petroleum Corp. Home: P.O. Box 2986, Khartoum, Sudan
	JICA Mr. Shoji NISHIKAWA Training Officer in Charge Office: #1, 2-chome, Nishi-shinjuku Shinjuku-ku, Tokyo 160, Japan	JICA Mr. Yoichiro MOTOYAMA Training Coordinator Office: #1, 2-chome, Nishi-shinjuku, Shinjuku-ku, Tokyo 160, Japan

(3) 講師氏名リスト

（敬称略）

氏　名	会　社　名	依　頼　先	電　話　番　号
平川芳春	日揮㈱	本人	月水金(542) 8561 火(588) 7695 金(279) 5441
灰谷佳朗	三菱化成㈱	有機事業部長　皆川進	(283) 6689
市東正利	住友化学工業㈱	取締役支配人　堀英太郎	(278) 7060
椿　誠	三井東圧化学㈱	人事部長　志水修	(581) 6111
武藤伸次郎	〃	〃	〃
江口知己	〃	〃	〃
斉藤修郎	〃	〃	〃
芝尾紘一	三井石油化学工業㈱	人事部長　若松司	(580) 3611
川副正人	〃	〃	〃
片岡俊樹	〃	〃	〃
高橋克行	〃	〃	〃
跡部輝彦	旭化成工業㈱	本人	(507) 2100
大橋俊英	三菱油化㈱	〃	0593 (46) 1111
鈴木竜之	〃	〃	(283) 5562
斉藤　修	旭硝子㈱	〃	(218) 5419
木口智司	住友化学工業㈱	工務部長　川崎昭三	(278) 7131
上尾敬三	〃	技術部長　石渡林太郎	(278) 7120

氏　　　名	会　　社　　名	依　　頼　　先	電　話　番　号
登　原　明　史	旭　　ダ　　ウ　　㈱	取　締　役　　田　崎　吉　弥	044（271）2586
寺　西　　　丕	日　本　合　成　ゴ　ム　㈱	取　締　役　　市　川　龍　夫	（541）4111
平　井　満　夫	日本触媒化学工業㈱	本　　人	（502）1651
奥　村　　　統	ラ　イ　オ　ン　㈱	〃	（613）6081
高　岩　和　雄	千代田化工建設㈱	〃	（456）1211
土　屋　泰　昭	東　　　レ　　　㈱	取　締　役　　横　内　　　澪	（245）5598
日　下　芳　春	日　本　石　油　化　学　㈱	常務取締役　　馬　替　　　泰	（501）7311

(4) 研修旅行日程

OBSERVATION & STUDY TOUR ITINERARY

March 1 1982 to March 6 1982

Date & Time		Activities	Transportation Mode	Accommodation
March 1 (Mon)	0700	Leave Hotel for Tokyo Station	Shinkansen (Bullet Train) Lv. Tokyo 0743 Arr. Mishima 0847	Dai-Ichi Washington Hotel (Nagoya) Tel. (052)-951-2111
	0900 - 1600	Mishima Plant, Toray Industries, Inc.	Shinkansen Lv. Mishima 1623 Arr. Nagoya 1806	
2 (Tue)	0830	Leave Hotel	Chartered bus	
	0930 - 1300	Tour of Toyota Motor Co., Ltd.		Nara Hotel (Nara) Tel. (0742)-26-3300
	1530	Move to Nara	Rail	
3 (Wed)	0900	Leave Hotel		
	1000 - 1200	Visit Tenri Plant, Sekisui Chemicals Co., Ltd.	Bus?	
	1330 - 1530	Visit Nara Plant, Sekisui Plastics Co., Ltd.		Umeda OS Hotel (Osaka) Tel (06)-312-3331
	?	Move to Osaka	Rail	
4 (Thu)	0800	Leave Hotel	Rail	
	1000 - 1400	Visit Kadoma Plant, Matsushita Electric Co., Ltd. (National Brand)	Rail	Same as above
5 (Fri)	0830	Leave Hotel	Rail	
	1000 - 1400	Visit Sakai Plant, Mitsui Toatsu Chemicals Inc.		Same as above
6 (Sat)	1022	Leave Hotel -- Return trip to Tokyo	Shinkansen	

NOTE: 1. Notify Hotel Front Desk dates of departure and return and check excessive baggage following their instructions.
2. Travel light; carrying of suitable rainwear e.g. umbrella, raincoat is advisable.

(5) 講師派遣先企業リスト

会　社　名	電　話	〒	住　　　　所
日　　　　揮	279−5441	100	千代田区大手町2−2−1　新大手町ビル
三井東圧化学	581−6111	100	千代田区霞ガ関3−2−5　霞ガ関ビル
三井石油化学	580−3611	100	同　上
三　菱　油　化	283−5511	100	千代田区丸の内2−5−2　三菱ビル
三菱化成工業	283−6111	100	同　上
住友化学工業	278−7000	103	中央区日本橋2−7−9　住友日本橋ビル
旭　化　成　工　業	507−2730	100	千代田区有楽町1−1−2　日比谷三井ビル
日本石油化学	502−1561	105	港区西新橋1−3−12
東　　　　レ	245−5600	103	中央区日本橋室町2−2
日本合成ゴム	541−4111	104	中央区築地2−11−24
旭　　ダ　　ウ	507−2730	100	千代田区有楽町1−1−2　日比谷三井ビル
日本触媒化学工業	502−1651	100	千代田区内幸町1−2−2　大阪ビル1号館
千代田化工建設	456−1211	108	港区三田1−4−28　三田国際ビル
ラ　イ　オ　ン	613−6081	132	江戸川区平井3−13−12
旭　　硝　　子	218−5419	100	千代田区丸の内2−1−2　千代田ビル

(6) 見学先リスト

見　学　先	依　頼　先
1. 海水淡水化茅ヶ崎臨海研究所	（財）造水促進センター 〒167　港区赤坂２－３－４ ランディック赤坂ビル 理事長　　外島健吉
2. 住友化学工業　千葉工場	本　社 〒103　中央区日本橋２－７－９ 住友日本橋ビル 取締役支配人　堀　英太郎
3. ブリヂストン・タイヤ　東京工場	本　社 〒104　中央区京橋１－10－１ 社長　　服部邦雄
4. 東レ　三島工場	本　社 〒103　中央区日本橋室町２－２ 取締役　　横内　溌
5. トヨタ自動車工業　豊田工場	本　社 〒471　愛知県豊田市豊田町１ 公報部長　　築城通雄
6. 積水化成品工業　天理工場	東京事務所 〒106　新宿区西新宿２－１－１ 新宿三井ビル 取締役　　長谷川整司

見　　学　　先	依　　頼　　先
7. 積水化学　奈良工場	東京本社 〒105　港区虎ノ門3－4－7 森ビル36 総務部長　井　手　元　治
8. 松下電器産業　技術館	東京支社 〒105　港区芝公園1－1－2 社　長　山　下　俊　彦
9. 三井東圧化学　大阪工業所	本　社 〒100　千代田区霞が関3－2－5 霞が関ビル 人事部長　志　水　修
10. 日　揮　横浜事業所	本　社 〒100　千代田区大手町2－2－1 新大手町ビル 取締役　加　藤　房之助
11. 石川島播磨重工　横浜工場	本　社 〒100　千代田区大手町2－2－1 新大手町ビル 輸出統轄部中近東担当課長 鈴　木　健　三

(7) カントリーレポート

I. INTRODUCTION

1. <u>Presentation of SONATRACH</u>

SONATRACH, la Société Nationale pour la Recherche, la Production, le Transport, la Transformation et la Commercialisation des Hydrocarbures, has been, for the last two years, under complete restructuration - The purpose of this difficult and complicated task is:

- to decentralize which means locating the newly created enterprises all over the country according to their functions and assignments. Bureaucracy is then, some - how, eliminated and there is obviously a better decision making process.

- to manage better a company which is becoming too big.

Nine enterprises have then be created:

- E.R.D.P: Entreprise de Raffinage et de Distribution des Produits Petroliers (Refining and Supplying Petroleum Products Enterprise).

- E.N.P.C: Enterprise Nationale de Plastiques et Caoutchouce (Plastics and Elastomers Enterpirse).

- E.G.T.P: Entreprise des Grands Travaux Petroliers (work related to Petroleum Field Enterprise).

- E.NA.FOR: Entreprise Nationale de Forage (Oil Drilling Company).

- E.N.T.P: Entreprise Nationale de Travaux aux Puits (Oil Wells Work Enterprise).

- ENAGEO: Entreprise Nationale de Geophysique (Geophysics Enterprise).

- ENGCB: Entreprise Nationale de Génie-Civil et Bâtiment (Civil Engineering Enterprise).

- E N S P: Entreprise Nationale de Service aux Puits (Services in Oil Wells Enterprise).

- E N C A: Entreprise Nationale de Canalisations (Pipes and Canalizations Company).

The first five enterprises have been officially created. The others will be very soon.

In addition to these enterprises two new divisions will be created very soon:

the Petrochemistry Division

the Fertilizers Division

these two divisions will become enterprises in the near future.

2. Existing Algerian Companies related to Petrochemistry Industries

S N I C : Société Nationale des Industries Chimiques

S O N I C: Société Nationale des Industries de la Cellulose

SONITEX : Société Nationale des Industries Textiles

S N M C : Société Nationale des Matériaux de Construction

SONELEC : Société Nationale d'Electricité

SONIPEC : Société Nationale des Peaux et Cuirs

E.N.P.C : E.R.D.P (as defined in 1.)

3. The Development of Petrochemistry in Algeria: a must

The development of Petrochemistry in Algeria is a must for many reasons:

- It will allow a quicker development of the industry of transformation of petrochemical products, which is beyond the petrochemical industry.

- It will realize the integration of the Refining Industry.

  This will contribute to affirm our economic independance

- It will make our natural resources valuable in one hand and make us import less in another hand (which leads us to an economy of hard currencies)

- It will improve the technical quality of our personnel.

- It will create jobs in the industry of transformation of the petrochemical raw materials.

II. EXISTING PETROCHEMICAL UNITS

1. Methanol and Synthetic Resins Complex of Arzew

1.1 Main Units

Main Units	Production (T/Yr)
- Methanol unit	100.000
- Formaldehyd unit	15.250
- Phenolic resin unit	5.900
- Ureal resin unit	8.000
- Melaminic resin unit	500

1.2 Principal Raw Materials

- Natural gas	70.000 T/yr
- Phenol	3.000 T/yr
- Urea	3.400 T/yr

2. Plastic Complex of Skikda

2.1 Main Units

Main Units	Production (T/Yr)
- Ethylene unit	120.000
- Low density polyethylene unit	48.000
- Vinyl chloride monomer unit	40.000
- Polyvinyl chloride unit	35.000
- Chloride unit	36.000
- Soda unit	42.000

2.2 Principal Raw Materials

- Ethane	167.970 T/yr
- Sodium chloride	70.560 T/yr

3. Aromatic Production Units of Skikda Refinery

3.1 Main Units

	Production (T/yr)
Aromatic Extraction Unit:	
- Benzene	90.000
- Toluene	5.000
- Xylenes	247.000
- Para-xylene cristallisation unit	38.000

3.2 Principal Raw Materials

- Light reformat 285.000 T/yr
- Remaining heavy reformat 285.000 T/yr

4. Ammonia Units of Arzew and Annaba

4.1 Ammonia and Phosphatic Fertilizers Complex of Arzew

4.1.1 Main Units

	Production (T/yr)
a) The first units	
- Ammonia unit	1.000
- Nitric acid unit	400
- Urea unit	400
- Ammonia nitrate unit	500
b) The extensions	
- Ammonia unit	1.000
- Nitric acid units (2)	400
- Ammonium nitrate units (2)	500

4.1.2 Principal Raw Materials

Natural gas: 647.520 N m^3/day (× 2)

4.2 Phosphate Fertilizers Complex of Annaba

4.2.1 Main Units

	Production (T/yr)
a) The first units	
- Sulfuric acid unit	1.500
- Phosphoric acid unit	500
- Soda tripolyphosphate unit	120
- Two fertilizers lines which can produce different formulas	500.000
b) The extension	
- Two nitrate acid units	400 T/yr (each)
- Two ammonium nitrate units	500 T/yr (each)
- Ammonia unit	1.000 T/yr

4.2.2 Principal Raw Materials

- Natural gas : 647.520 N m^3/day
- Phosphate : 4.268 T/day
- Sulphur : 1.036 T/day
- Potash sulphur: 859 T/day

III. PETROCHEMICAL UNITS TO BE BUILT

Before outlining the existing petrochemical units it is necessary to point out the fact that the development plan of petrochemistry in Algeria has been under study since 1973. At that time the policy was to satisfy all needs in petrochemical products plus the possibility of exporting if necessary. Seventy units were then supposed to be built in addition to a 500.000 T/year steam cracking. Afterwards a more mature plan has been designed taking into account the existing raw materials (Ethylene, Kerosene, Aromatics ....) in one hand and the needs to be fulfilled in the next decade and half in the other hand.

The order of priority of the petrochemical units that we outline in this report has been established under the following criteria:

- Existing raw materials (complete or partial)
- Fulfillment of the national market needs of the products that ask for a big demand.
- Economically feasible capacities even if they are designed for the national market only.
- There should be no major problems as for as locations are concerned.
- It should permit an economical integration

1. Proposed Units for the 1980 ∿ 1984 PLAN

1.1 Linear Alkyl Benzene Unit

Location	:	SKIKDA
Capacity	:	40.000 T/year
Raw materials	:	Kerosene + Benzene
Estimated demand (1990)	:	30.000 T/year
Planning	:	3/83 to 3/87

1.2 High Density Polyethylene Unit

Location : Skikda

Capacity : 20.000 T/year

Raw material : Ethylene

Estimated demand in the 1990's: 60.000 to 75.000 T/year

Planning : 01/84 to 01/88

1.3 Ethyl benzene by Alkylation Unit

Location : Skikda

Capacity : 103.000 T/year

Raw material : Benzene + Ethylene

Planning : 01/84 to 01/88

1.4 Steam Cracking Unit

Location : Skikda

Capacity : Ethylene : 300.000 T/year,
Propylene: 270.000 T/year

Raw material : Ethane + LPG

Planning : 01/84 to 01/89

2. First Priority Units to be Built in the Future Plans

2.1 Polyester Fibres Units

- D M T Unit

Location : Skikda

Capacity : 56.000 T/year

Raw materials: Para-xylene and Methanol

- Ethylene Oxide Unit

Location : Skikda

Capacity : 60.000 T/year

Raw materials: Ethylene

- Ethylene Glycol Unit

  Location : Skikda

  Capacity : 58.000 T/year

  Raw material : Ethylene Oxide

2.2 Plasticizers Unit

- Ortho-Xylene Extraction Unit

  Location : Skikda

  Capacity : 44.000 T/year

  Raw material : Xylenes mixture

- Phtalic Anhydride Unit

  Location : Skikda

  Capacity : 45.000 T/year

  Raw materials: Ortho-xylene

- Oxo-Alcohol Unit

  Location : Skikda

  Capacity : 40.000 T/year

  Raw materials: Propylene + H_2, CO/CO_2

- DOP/DBP Plasticizer Unit

  Location : Skikda

  Capacity : 40.000 T/year

  Raw materials: 2 Ethyl hexanol, n Butanol, Phtalic Anhyrdride

2.3 Vinyl Polychloride Unit (PVC)

- Vinyl Chloride Monomer Unit (V C M)

  Location : Skikda

  Capacity : 83.000 T/year

  Raw materials: Ethylene + Chloride

- P.V.C Unit

  Location : Skikda

  Capacity : 80.000 T/year

  Raw material : V.C.M.

2.4 Polystyrene Unit

- Ethyl Benzene Unit

  Location : Skikda

  Capacity : 69.000 T/year

  Raw material : C_8 Aromatics

- Styrene Unit

  Location : Skikda

  Capacity : 150.000 T/year

  Raw material : Ethyl benzene

- Polystyrene Unit

  Location : Skikda

  Capacity : 75.000 T/year

  Raw material : Styrene

2.5 Polypropylene Unit

Location : Skikda

Capacity : 50.000 T/year

Raw Material : Propylene

2.6 Linear Low Density Polyethylene Unit

Location : Skikda

Capacity : 100.000 T/year

Raw material : Ethylene

2.7 Acrylonitrile Unit

Location : Skikda

Capacity : 20.000 T/year

Raw materials: Propylene, Ammoniac

3. Second Priority Units

3.1 Caprolactam Unit for Polyamids

3.2 Cumene and Acetone/Phenol/Unit

3.3 Units for Polyurethane

- Propylene Oxide Unit
- Polyol Unit
- Phosgene Unit
- Toluene diisocyanate Unit

3.4 Elastomer Units

- Polybutadiene Unit
- Styrene - Polybutadiene Unit
- Carbon Black Unit

3.5 Methyl Terbutyl Ether (MTBE) Unit

3.6 Polymethyl Metacrylate Unit

- Methyl Metacrylate Unit (M M A)
- Polymethyl Metacrylate Unit (P M M A)

3.7 Acrylonitrile Butadiene Styrene Resin Unit (A B S)

3.8 Acetic Acid Unit

3.9 Units for Pure Chemistry

Ethanol, Ethyl Acetate, Ethyl glycol Acetate, Monochloracetic acid, 2-4 Dichlorophenol, 2-4 Dichlorophenoxyacetic acid.

IV. CONCLUSION

The petrochemical industry is a young and active industry in Algeria. It is quite obvious that because of the existing petrochemical raw materials, among other factors, this industry has to develop itself in the near future. The impact that this industry will be having to the other industries is very big.

Algeria is looking forward to cooperating with all countries that will help in an efficient way and that will make the technological transfer as good as possible.

Petrochemicals in Arab Republic of Egypt

Virtually no plastic raw materials are produced in Egypt. Thus the industry relies on imports of raw materials, nowadays.

The newly formed Egyptian Petrochemical Company, (Espetco) whose majority shareholder is the state petroleum authority, Egyptian General Petroleum Corporation, has selected the B.F. Goodrich process for its polyvinyl chloride project in Alexandria. The plant will form the 1st part of a major three-phase petrochemical project - Egypt's first - whose cost has been estimated at between $400 - 500m.

Under the terms of its contract B.F. Goodrich will provide process technology and basic engineering for a 80,000 MTA suspension PVC plant which in the initial stages will be based on imported VCM.

The second phase of Epetco's project will cover the construction of 90,000 MTA low density polyethylene and 40,000 MTA high density polyethylene plants. There is also a possibility of a vinyl chloride monomer unit at this stage with a capacity sufficient to feed the PVC plant.

In the final stage of the project Epetco plans to build a 200,000 MTA gas - based ethylene plant. Feed stock of the unit will be available from two locations - the Abugharadik and Suez fields.

F.

Petrochemical Industry in Jordan

Jordan is a developing Arab country centrally located among the countries of the Middle East with a population of over 2.25 million people. Jordan is experiencing rapid economic development. The industrial sector of the economy, which contributes about (24.1%) of the gross domestic product, has been growing rapidly in recent years.

Jordan's principal industries are the phosphate, potash, cement, petroleum refining and fertilizers. The remaining industrial enterprises are smaller industries producing consumer goods largely for the local market.

As for the petrochemical industry in Jordan, there are no investments in basic and intermediate petrochemical products, This is due to the lack of raw materials such as crude oil, natural gases and napha needed for such industries.

Surveys and exploration for oil are still underway in Jordan but so far studies haven't proved yet the presence of oil. Thus Jordan petrochemical industry constitutes of the production of final petrochemicals such as:-

1. Polyvinylchloride:

   A plastic material produced by the polymerization of vinylchloride. There are two plants each producing 3,000 tons/year of P.V.C.

2. Polyvinylacetate:

   A necessary raw material for the manufacturing of paints. produced by the polymerization of vinyl acetate. There is one plant producing P.V.A. with a capacity of 4,000 tons/year.

3. Polyester resins:

The plant will start production in late 1983 with a production capacity of 4,000 tons/year.

4. Relon:

Polyester reinforced with fiberglass. Production will start in 1983. The production capacity is expected to reach 1,500,000 m^2/year.

5. Alkyds:

A raw material for paints. A 1,000 tons are being produced per year.

6. Oil products:

Jordan obtains its supplies of crude oil from Saudi Arabia. About (1,814,460) tons of crude oil were refined at the Jordan refining company in 1980. The company was first established in 1958. The production has increased from 1.8 million tons/year in 1975 to 4.5 million tons/year in 1981 as result of the third expansion project designed and implemented by Romanian and American companies.

Fuel oil constitutes 28% of all refinery products which are:

Product	Tons/yr
Liquid petroleum gas	40,940
Gasoline	266,311
Avtag	19,865
Avtur	200,031
Kerosine	169,490
Diesel oil	470,383
Fuel oil	497,226
Asphalt	95,929

7. As for future projects, feasibility studies are still being prepared for a new plant for the production of ureaformaldehyde resins and polyurethane elastomers.

From the previous discussion, it should be clear now that the petrochemical industry in Jordan is still new and growing inspite of the many obstacles the industry is facing mainly due to the lack of raw materials on which the industry depends, also the shortage of technical expertise and the small local market are two major problems the industry has to face.

Report of Participant in the

"Petrochemical Ind. in Middle East Countries"

1. Petrochemical Ind. in Iraq.

1.1 Fertilizer plants in Basrah area, built by Mitsubishi of Japan.

1.2 Petrochemical Complex No. 1 in the construction phase, by Lummus of U.S.A.

Total annual production capacity: 150,000 MT

2. Particular problems of interest.

Hoping that the individual participant would get their chance for each to seek his own interests, beside completing the planned course. My points & problems of interests are:

2.1 The feasibility of the use of comprehensive computer system to cover the following activities.

- Administration & business
- Lab control system
- Maintenance system
- Process control for most of the process units

2.2 Preventive maintenance system

2.3 Inspection system

2.4 Equipment & material for feasible stretch or shrink wrapping system.

2.5 Samples of stock control print outs.

2.6 Disposal of solid wastes

2.7 The use of Philips process H.D.P.E. for crates.

2.8 Group visits for to places of activities on National festivales & to International Fair.

2.9 My wish, and for some time now, is to be invited to typical Japanese home to witness their traditions. Hope my wish become true before going back home.

3. Future Prospects of Petrochemical Industries in Iraq.
To my knowledge, Toyo Eng. Corp. was awarded the contract for feasibility study for to build up Iraq second petro-chemical.

4. Organization where I work
State Enterprize for Petrochemical Ind.
P.O. Box 933
Basrah - Khor El-Zubair

— Report —

Petrochemical Industry of Kuwait

Kuwait mainly produces Ammonia and Urea, beside some others in a small capacities like table salt (Nacl) and ($C\ell_2$) chlorine.

The existing units in Kuwait area:

- Ammonia plant with a design capacity of 2,000 ton/day.
- Urea which produced from ammonia. The Urea unit has a design capacity of 824,000 ton/year.
- (NaCl) production with producing capacity of about 17,000 ton/year.
- Chlorine ($C\ell_2$) - with a production capacity of about 9,000 ton/year.
- There is a new project which is under study to produce aromatics like:
    - Benzine
    - Parazaylene
    - Orthozaylene

So, those are the products which Kuwait produces right now, and the others which may take place in the future. The State of Kuwait wishes to expand its petrochemical industry in order to utilize its national resources as crude oil and its products and the associated gases which are produced with the crude production.

So the coming years will show us more development and expansion in the Kuwaity Petrochemical industry.

I am working in the ministry of oil. This ministry has the task of applying certain regulations on the petrochemical and petroleum companies to assure the best utilization of petroleum resources and petrochemical production.

I am a chemical engineer. We study any suggestion from our petroleum companies to make some technical expansion there, or to have some new equipments to put into operation. We study all these technical subjects in order to give them as a ministry the notice of approval. Beside that the ministry technical staff study and approve any new project related to our petroleum petrochemical companies and give them the approval to start.

Morocco and the Oil

Over the last few years, Morocco's consumption of primary energy has increased by 8% per year. This consumption reached in 1978, the eqivalent in oil of 4,200,000 tons. This represents a per capitarate of consumption of approximatly 0.25 TEP. This rate is actually higher for urban centers, given that 65 to 70% of the population is rural and that certain of their new forms of energy consumption, in particular bromass, have not been counted for. The supply system in Morocco is characterized by a preponderance of oil products, which are almost entirely imported, currently at the rate of almost 80% of total supply. This trend will over the long be accentuated since the share of oil products for the year 1985 is estimated approximately 85%.

The oil bill which was only 220 million dirhaus in 1973 reached 2 billion dirhaus in 1978 (1). It thus went from 4.8% to 20% of the total value of the country's imports . Given the recent increases in the price of oil out the volume of imports, this bill will become still higher for 1982 since it is forecasted that it will reach approximately 3 billion dirhaus.

I. MOROCCO'S Energy Situation

a. Oil Products

Consumption of oil products has, over the last 10 years, undergone signification reached, undergone significant growth, at an average annuel rate of 10% consumption reached 3,331,000

(1) 1 dirhau = 0.25 USD

tons in 1978 and 4,500,000 tons in 1982. The studies wish have been undertaken have made it possible to estimate the rate of growth for the coming years at approximately 8% per year which will bring needs to 7 million tons in 1985 and 10 millions in 1990.

The needs for oil products are satisfied using the crude oil which is virtually all imported. The crude oil imported is processed in the two refineries which exist in the country.

- that at Sidi Kacew, the oldest, which has an annual processing capacity of 1 million ton, and
- that of the Samir, located at Mohammedia, and whose capacity, thanks to successive extensions, reached 6,2 millions tons at the beginning of 1984 (with a project for manufacture of lubricating oil, which will have an annual capacity of 100,00 tons.

The rapid growth rate of consumption of oil products, as indicated by the numbers given above, makes it possible to forecast that the Sidi Kacew refuiery will be fully utilized as early as 1982, and that of the Samir around 1984/1985. Beyond this date, and if the rate of growth and consumption continues, Morocco Would, in order to meet its need for oil products, be obliged to build the equivalent of one refuiery of 3 million tons every 4 to 5 years.

b. Petrochemical Products

The Moroccan consumption of petrochemical products is relatively weak it is about 0,7 kg per inhabitant (In France 13 kg per inhabitant). But if its overage growth was of

15% per inhabitant between 1971 ∿ 1981 it has doubled in five years, it is normal for a country which is on the process of being developed industrially whereas this rate has dropped in Europe flow 8 to 10%.

- Morocco has only one société of petrochemical industries it's "SNPP".

- The Morroccan consumption of plastic articles:

Importations

Polyethylene	23,450
P.V.C	12,770
Other materials	25,780
Total	62,000 T

SNEP abilities

P.V.C	suspension	20,000 T per year
	emulsion	5,000 T per year
	Total	25,000 T per year

- National consumption

- Imported vinyle resins	12,770 T
- Pure resins (out of additives)	11,710 T

Statistics statement

Shoes	40.2%
Bottle-works	20.6%
Sheets	9.8%
Cable-works	8.5%
Imitation leather	3.7%
Other products	17.2%

c. Coal

Morocco has at Jerada in the north of the country an anthracite mine which supplies all of the national production.

This mine was operated by societe Maroccan des charbonnages Nord Africans (C.N.A). The reserves of this deposit, which is the only coal basing being worked in Morocco and North Africa, are estimated at 100 million tons. Other possibilities also exist in this region.

Production reached 720,000 tons in 1982 and will increase to 1 million tons per year by approximately 1985.

Most of this production is comprised of high quality coal which is used by the thermal-electric plant installed in 1971 at the mine site. The remainder of the production is in part exported (8% of production) and in part consumed by local industry (45,000 to 55,000 tons/year).

Prospect for development of the nation's resources

This substantial effort to equip the country industrially is necessary to meet the growing needs for hydrocarbons however, the country.

In effect, despite the existence of equipment suited to the country's hydroelectric potential as well as its increased production of anthracite. The share of local resources in satisfying its overall needs will continue to decrease. The inpact of importing products whose cost is always increasing, will weigh more and more heavily on the country's trade balance.

New orientations, whose ultimate objective will be the long term energy independence of the country have been defined both in terms of the particular situation in Morocco and the prospects in this area of the world as a whole.

Special attention is being given to solar energy, given that the Moroccan territory gets sunlight all year round the period of sunlight in our country is estimated at 3,000 hours per year and the energy associated therewith at an of 200 Kcal/cu^2. Moreover, with a widely disporsed rural population, as well as the density of its population and its agricultural occupation, Morocco presents particularly favorable conditions for the use of this kind of energy.

PETROCHEMICAL INDUSTRIES IN QATAR

INTRODUCTION:

Because State of Qatar is an oil producer country and for the last ten years ago, associated gas once was flared for the utilization of energy resources (gas) in Qatar, it had been decided to establish petrochemical industries utilizing this gas.

1. Petrochemical Complex
2. Fertilizer Plant

1. Petrochemical Complex:

Feed Stock: Ethane rich gas

Product:
1. Ethylene 280,000 t/year
2. Low density polethylene 140,000 ton/year
3. Sulphur 46,000 t/year

THE STEAM CRACKING PLANT:

The steam-cracking plant is fed with a gas called "ethane rich gas" which is composed of approximately 60% ethane, 20% methane and 20% acid gases. The gas comes from the NGL plants of QGPC.

NGL Plants gather all associated gases, both from onshore and offshore wells and after processing they deliver to QAPCO upto 600,000 tons/year of ethane rich gas needed for producing 280,000 T/year of high purity ethylene (99,95%). Steam cracking involves the pyrolysis of hydrocarbons in the presence of steam at a temperature of 850°C at very low pressure, and with the absence of catalysts.

The molecules of hydrocarbons are there by "cracked" to give smaller molecules which are more reactive and can easily be used for chemical reactions.

The steam cracking plant comprises mainly of:

- The gas treatment section
- The cracking section
- The separation section

a) The gas treatment section:

The cracking concerns mainly ethane. Before sending it to the furnaces, the ethane rich gas must be treated for the following to obtain a gas with ethane high content (95%).

1. Removal of acid gases
2. Removal of methane.

The removal of acid gases (H_2 S and CO_2) is made through a washing unit using Deethanolamine (D.E.A) for absorption.

The "sweet gas" is then sent to the first Demethanizer for the removal of methane. Methane goes to the fuel gas system, the ethane high content gas is either directed to buffer storage (2 spheres each 4,000 m^3) or forwarded directly to the cracking furnaces.

The acid gases recovered from the washing unit are sent to the sulphur recovery unit. Inside the unit H_2S is transformed to sulphur by using the Claus catalystic process. Sulphur leaves the unit as liquid. A prilling unit receives the liquid sulphur and delivers solid sulphur pellets which are sent as bulk to a 8,000 T storage warehouse. The warehouse is equipped with an automatic reclaimer device linked to the loader placed on the wharf. Sulphur will be loaded directly as bulk into carrier ships berthed to the quay. Expected solid sulphur production is 45,000 T/year.

b) <u>The cracking section</u>:

7 furnaces have been erected for receiving the ethane high content gas, one is kept as spare, 6 allow the full production of ethylene. Before entering the furnaces, steam is added to the gas in order to facilitate the reaction and to reduce the deposition of "coke" inside the cracking tubes. Tubes are heated up to 850°C and gas + steam progress very quickly under less than half second for the total transit time. From the economical point of view, the gas is preheated by the exhaust smokes of the furnaces and the very high temperature cracked gases are cooled by producing high pressure steam.

c) <u>The separation section</u>:

3 sub-sections can be observed:

1. The hot sub-section
2. The compression sub-section
3. The cold separation sub-section

1. <u>The hot sub-section</u>

After passing through a first exchanger used for steam production, cracked gases are cooled very quickly in a "quench" tower. Temperature is brought down to 35°C in a very short time. Fast cooling is needed to avoid the reversibility of the cracking operation. Before being directed to the compression sub-section, water and heavy pyrolysis oils are removed from the cracked gases.

2. The compression sub-section:

The higher pressure needed at the inlet of the cold separation is provided by a 5 stages centrifugal compressor. Pressure is built upto 36 bars. In between the fourth and fifth stages of the compressor, cracked gases go through a washing unit for the removal of acid gases and heavy pyrolysis oil. When leaving the compressor, gases cross a drying unit for complete removal of water before being cooled down at very low temperature.

3. The cold separation sub-section:

Cracking of ethane is a very complex reaction which in fact gives hydrogen and a very large range of hydrocarbon products but of course with a priority to ethylene. Recovery of various components is made in several steps by fractionated distillation. To obtain the foregoing step, cracked gases must be cooled down very deeply, down to minus 95°C. This can be done by using successively two different fluids, first liquid is propylene, second liquid ethylene.

Progressively recovered are:

- Hydrogen and methane, recycled as fuel gas. However, part of hydrogen will be purified and used for hydrogenating C_2 and C_3 Hydrocarbons.
- C_2 cut comprising ethane, ethylene and acetylene. Acetylene is converted into ethylene by hydrogenation. The final C_2 splitter tower separates ethylene from

ethane. Ethane is recycled to the cracking furnaces. Very high purity ethylene (minimum 99, 95%) is sent either to the storage (30,000 m^3 - 104°C atm. pressure) or to the Polyethylene plant.

Ethylene storage is connected to the loading arms, located on the wharf. Specialized ship tankers berthing to the wharf can be directly loaded or unloaded from or to the storage tank.

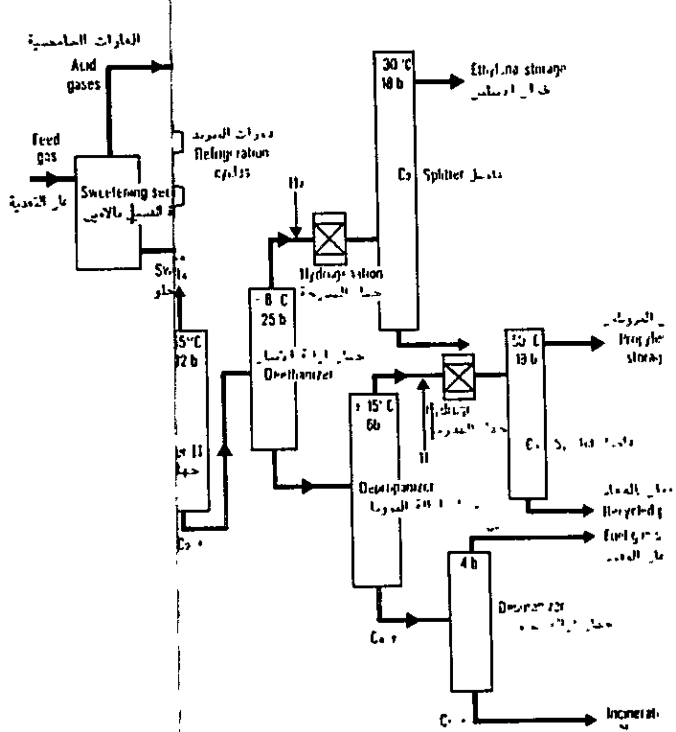
- C_3 cut comprising mainly propane and propylene. A hydrogenation reactor is also used for improving propylene recovery. Propane is separated from propylene and recylced.

  Propylene is sent to storage (one 1,000 m^3 sphere) and will be used partly to fill up the propylene cooling system and partly to feed the Polyethylene plant as a transfer agent.

  Expected propylene production is 5,000 T/year.

- C_4 cut is sent back to the fuel gas system.

- The remaining heavier hydrocarbons are burnt in an incinerator.


Acid
gases
Feed
gas
Refrigeration
cycles
H₂
30 °C
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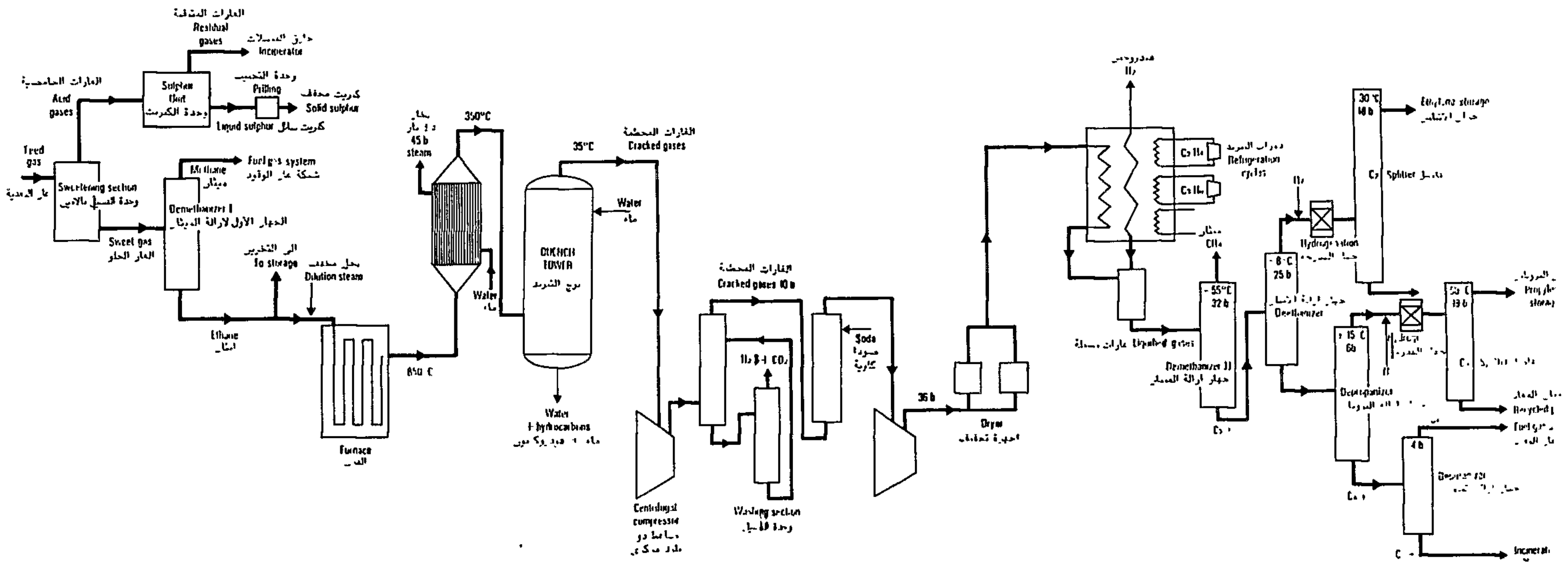
Splitter
Hydrogenation
- 8 C
25 b
Deethanizer
4 b
Incinerat

Steam cracking process عملية التحطيم البخاري



THE POLYETHYLENE PLANT

The polyethylene plant has been designed for producing 140,000 T/year of low density polyethylene in a single line. It is the second plant in the world having such a unit capacity after COPENOR in France, a sister company, owned by CdF Chimie and QGPC. The plant utilizes CdF Chimie's process.

The plant comprises of:

a) The compression section
b) The polymerization section
c) The homogenization and bagging section.

a) The compression section:

Ethylene, with a minimum purity of 99, 95% received from the ethylene plant is first compressed upto 250 b through the primary compressor. The second compressor will then boost the pressure upto 1,000 to 2,000 bars. It must be noted that this compressor is driven by an electrical motor of 17,000 kW. High pressure ethylene is sent to the polymerization section.

b) The polymerization section:

High pressure ethylene including or excluding transfer agent, is introduced inside a stirred autoclave reactor. By the introduction of catalyst agent, the polymerization reaction is initiated and controlled. By polymerization reaction, it must be understood that ethylene molecules join together and are strongly linked to form a very long molecular chain of polyethylene. Conversion from ethylene to polyethylene is partial, conversion factor can reach values upto 20%. Quality of the polyethylene is strictly dependent on pressure and temperature inside the reactor. Accurate control of these two parametrics allow to produce the various qualities needed. Inside the reactor, ethylene and polyethylene are fully mixed. For separating ethylene from polyethylene, the mixture is sent to a separator through the automatic reactor diffusion valve. Pressure is dropped down to 250 bars, so most of ethylene is recovered and sent back after cooling to the secondary compressor section. From the bottom of the separator, the polyethylene is forwarded to medium and low pressure hoppers, where the ethylene continues to be removed. The last hopper is fitted upon an extruder. The extruder contributes to the homogenization of the product and allows on-line introduction of various additives, if needed such as : slip agent anti-oxydant, anti-U.V. or anti-blocking agents etc.

At the end of the extruder an underwater pelettizing device produces polyethylene pellets. After removal of water, pellets are sent to the homogenization through automatic weighing unit, controlling the output of the unit.

c) The homogenization and bagging section:

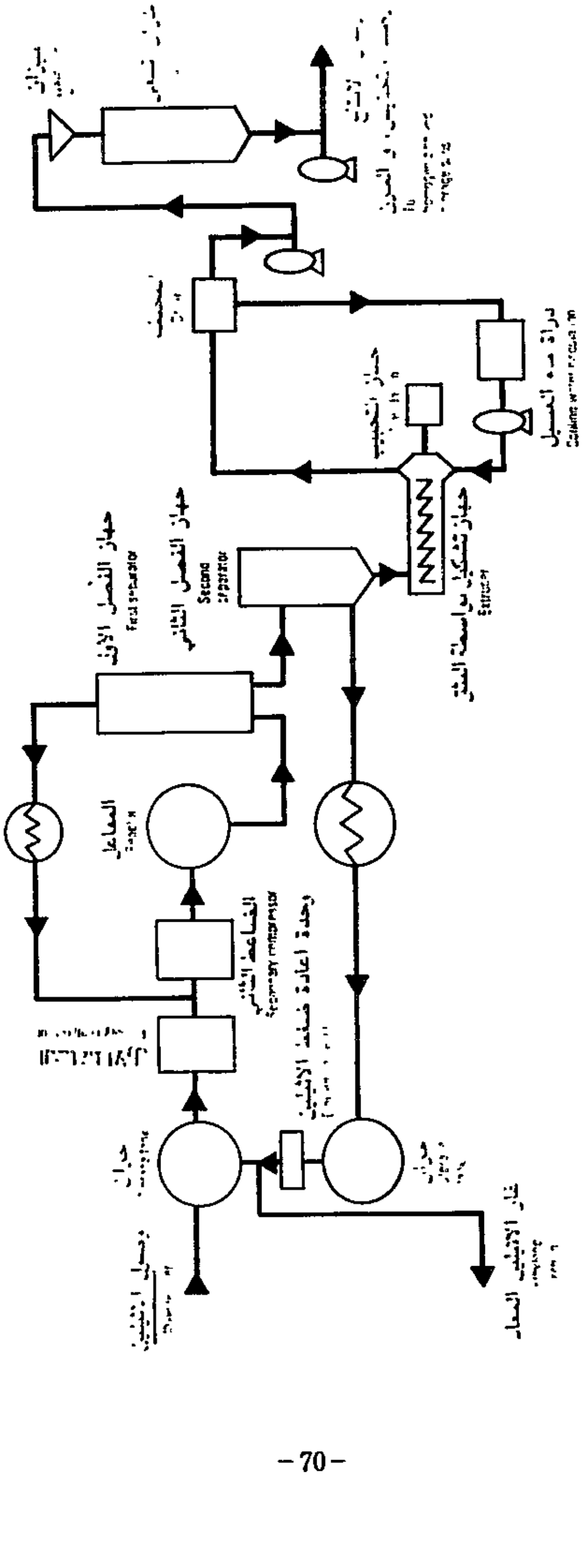
To ensure the steadfastness of the qualities, polyethylene is homogenized by batches in silos. By this way, a complete uniformity of the properties can be obtained. After homogenization, the product is sent either to the storage silos (250 T each) or to the bagging section.

Storage silos have been designed to allow direct bulk loading in trucks. Bagging is made through two fully automatic lines. Valve bags are used to receive 25 kg of polyethylene each. This kind of abg, with its square shape, allows the building up of nice pallets easy to handle and to store. Palleting is also fully automatic and the pallets are wrapped by a shrinkable film. Thus handling is easy to do, with no risk to pull down the pallets. Pallets are then stored in a warehouse of 24,000 m.

A large part of the polyethylene will be exported by ship. It could be loaded either directly in pallets or inside containers. A mobile crane specially designed for container handling is on site. A jetty crane also equipped with container device can directly load either pallets or containers inside the ship. Some polyethylene will be delivered by trucks for all regional sales.

FUTURE EXPANSION:

It is planned to expand the plant to produce high density polyethylene 70,000 Ton/year.


جهاز الفصل الأول
First separator
جهاز الفصل الثاني
Second separator
المفاعل
الضاغط الثاني
Secondary compressor
وحدة اعادة ضغط الاثيلين
جهاز تشكيل بواسطة البثق
Extruder
غاز الاثيلين المعاد

2. Fertilizer Plant:

Feed stock: Natural gas

Product : 1. Ammonia two lines.
Each line with a total capacity of 900 tons/day.

2. Urea - two lines
Each line with a total capacity of 1,000 tons/day.

NOTE: First production line started in 1974, and the second started in 1979.

THE PROCESS:

Natural gas from the oil fields is the raw material for production. Small amounts of sulphur compounds, mainly H_2S in the feed gas are removed in sulphur removal plant. The gas is then passed to the reforming section, where gas, steam and air reacts at high temperature in the presence of catalyst to form basically carbon monoxide (CO) and hydrogen. The nitrogen needed for the ammonia reaction is introduced through the air.

The reformed gas passes through various convertion and purification stages. In the CO-shift, CO contained in the gas is converted into hydrogen and CO_2. The CO_2 is removed in the CO_2 removal and used as raw material for urea.

AFter another conversion stage, the methanation, where traces of CO and CO_2 are removed, the gas is compressed and let to the ammonia synthesis section, where it is converted to ammonia at high temperature and pressure (approximately 800°F and 3,100 spi).

Liquid ammonia and CO_2 are the two components used in the urea production. These components are introduced in the urea autoclave at high pressure to form urea.

The liquid leaving the autoclave goes to the decomposition section where excess ammonia is recovered and returned to the synthesis.

After filtration, crystalling and centrifuging, the urea crystals are melted and prilled in a prilling tower to form a free flowing final product. From the base of the prilling tower this product is conveyed to the bulk storage.

THE FINAL PRODUCTS

Ammonia is shipped from QAFCO in a liquid state, cooled down to 34°C in special "Liquefied gas tankers". Ammonia is used as a raw material for the production of various grades of chemicals. The main consumer is the fertilizer industry. Liquid ammonia can also be used directly as a nutrient. The major part of the world's ammonia production is based on petrochemical raw materials as oil, naphta or natural gas.

FERTILIZER GRADE UREA

Urea is a fertilizer product of increasing importance. The product has a nitrogen content of 46.3% which is more than in any other fertilizer product. This means a saving in transportation costs as fewer bags are needed for the same amount of nitrogen. Prilled urea has good shipping qualities. It is free flowing and can easily be spread by hand or by mechanical means and it may also be used as spray solution alone or in combination with other nutrients.

NOTE:

The 2nd urea production line uses the evaporation process for urea production (not the crystallization process as in the 1st production line).

Saudi Arabia is a major crude oil producer in the world since the discovery of oil in its Eastern Province in the early thirties.

Saudi government increased its production which now is about 8.5 mbr. to get revenue to meet the demand of developing the country in many fields to create an opportunity of Saudi people to get the highest education to be able to build the country in the effecient way.

In the last decades the government has thought about the start of petrochemical industries which would be the best investment for raw material and human resource and create well-educated people to be able to run the factories.

Soudi Arabia has faced many problems such any developing country which they were the main objective of the government of Saudi Arabia.

1. Human resources

The government established Saudi Basic Industries Corp. (SABIC) to utilize the resources of the land minerals and petrochemical.

SABIC was very careful of solving these problems by choosing the partners and licensors who had and still have the best reputation, to get the highest benefits from them by training the Saudi men.

And now everything is going as planned and SABIC looks for the best.

The planned or recent development of SABIC's manufacturing programme are shown in the attached table.
The future prospected petrochemical industries are the downstream which the private sector will be involved.

SABIC's Manufacturing Programme

	Project	Location	Feedstock	Product	Capacity[1]
1.	Saudi Petrochemical Co.	Al-Jubail	Ethane	Ethylene	656,000
			Salt	Ethylene Dichloride	456,000
			Benzene	Styrene	295,000
				Ethanol	281,000
				Caustic Soda	377,000
2.	Saudi Yanbu Petrochemical Co.	Yanbu	Ethane	Ethylene	450,000
				LDPE[2]	200,000
				HDPE[3]	90,000
				Ethylene Glycol	200,000
3.	Al-Jubail Petrochemical Co.	Al-Jubail	Ethylene	LDPE[2]	260,000
4.	Saudi Methanol Company	Al-Jubail	Methane	Chemical-Grade Methanol	600,000
5.	National Methanol Co.	Al-Jubail	Methane	Chemical-Grade Methanol	650,000
6.	Arabian Petrochemical Co.	Al-Jubail	Ethane	Ethylene	500,000
				LDPE[2] & HDPE[3]	180,000
7.	Eastern Petrochemical Co.	Al-Jubail	Ethylene	LDPE[2]	130,000
				Ethylene Glycol	300,000
8.	Al-Jubail Fertilizer Co.	Al-Jubail	Methane	Urea	500,000
9.	Saudi Iron & Steel Co.	Al-Jubail	Iron Ores	Rods and Bars	800,000
			Natural Gas		
			Scrap Iron		
10.	Jeddah Steel Rolling Mill	Jeddah	Steel Billets	Rods and Bars	140,000

1 - Metric tons per year   2 - Low Density Polyethylene
3 - High Density Polyethylene

Sudan was exploring for oil since early 70's. Many companies were given licence to explore for oil in different parts of the country. In the period 1974 ∿ 78 Chevron Company explorations in the Red Sea area revealed a huge field of natural gas. According to Chevron report, eleven wells have been drilled in a marine platform and a reservoir of 170 BSCF of natural gas was believed to axist in addition to 9 MMB of light crude oil with an API of 54 degrees.

Other companies computed the reserved quantities to be 300 ∿ 1,500 BSCF. A Figure of 360 BSCF of natural gas was agreed upon to exist. This is almost,

$\frac{1}{75}$ the reserve of Algeria.

$\frac{1}{5}$ " Egypt.

In that time the country's interest was focusing on oil, since requirements in crude oil and finished products are imported from abroad. So companies were believed to shift for other parts in the country exploring for oil. Till now, oil field discoveries are promising.

Petrochemical industries present situation is very poor except for urea production in Khartoum. This plant had been studied before the announcement of the previous discoveries. Surplus naphtha produced from Port Sudan refinary was considered to be the feed stock, although, natural gas rich in methane fraction could be a better alternative.

Total capacity of this plant is believed to be 178,000 M.T/ Year of urea while the potential demand is computed to be 500,000 M.T./Year. 400,000 M.T/ of Urea will be overcomed by better utilization of 44 MMSCF of natural gas. Natural gas has been suggested to be used in the following:-

1. Urea fertilizer plant.
2. Electricity power generation.
3. Cement Factories.
4. Cotton seed processing.

I am interested in the following areas:-

1. Trends in the petrochemical industry,
2. Optimum utilization of natural gas.
3. Refining processes as important sources for obtaining olefins and aromatics,
4. Raw materials for petroleum chemicals,
5. Crude oil and natural gas as raw mateirals for petro-chemical industry,
6. Individual hydrocarbon and petroleum cuts as Feedstocks for petroleum chemical manufacture,
7. The influence of the main operating parameters upon conversion and yields in certain reactions of the petrochemical industry.

Future prospect of petrochemical industry in Sudan is promising. Methane will be separated from natural gas and will be used in the production of synthesis gas and hence ammonia, urea, methanol and oxo-alcohols. Or the production of acetylene.

After seperation of methane, olefins and aromatics will be obtained by steam cracking of ethane, propane, butane and natural gasoline. The following table represents yields obtained from these products by steam cracking of each component companied to the cracked naphtha, gas oil and Fuel oil. It follows that ethane give the largest yield of ethylene and negligible amounts of by - products. This makes produced ethylene from ethane much lower in cost than any ethylene produced from other raw material.

Industrial units often used ethene and propane in the ratio 50 : 50% weight and this will give the following products;-

Ethylene	75.5%
Propylene	12.2%
Gasoline	5.2%
Fuel gas	8.1%
Total	100.0%

Product	From Natural Gas			From Petroleum		
	Ethane	Propane	Butane	Naphtha	G.Oil	Fuel oil
Ethylene	80.5	42	42.8	31.2	28.7	28.3
Propylene	1.8	16.2	19.3	16.1	12.8	12.6
Buradiene	1.9	3.2	3.1	4.5	3.8	3.6
Aromatics	0.9	3.4	2.4	12.1	11.6	13.6

In case Gas oil is used as raw material, investment needed for steam cracking unit is almost 1.75 times that if ethane is used.

It is worth mentioning that, General Petroleum Corporation, a public corporation an affiliated to the Ministry of Energy & Mining is Managing petroleum sector in Sudan. Start from early exploration, production, transportation, refining, marketing, distribution any may be petrochemical industrialization in the future.

I have joined the service of General Petroleum Corporation since 1975 as a chemist, since that time I have worked in different sections at the technical department and held different responsibilities at different levels. I have contributed a lot in many fruitful studies. In 1977 I was nominated to attend a training course at Alexandria Petroleum Company - Egypt for one Year, during which I conducted advanced techniques in quality control for petroleum products, crude evaluation and refining techniques.

I joined the Lub oil & greases Section in 1980. In 1981 I was nominated to attend an international symposium held in Cairo on Development of Automotive industry, fuels and lubricants. I presented a paper on "power Alcohol" on behalf of the National Committee for "power Alcohol"!

The Lub oil and greases Section is responsible for imports programming issuing licence, selecting suitable and reputable brands, studying equivalents of lubricating oil & greases. Sorting out reasonable offers and conducting feasibility studies regarding this area.

References:-

1. Exploring for oil and ability to utilize gas - paper written by Dr. Omer El Sheikh - First Energy Conference Khartoum - Sudan.
2. Fundamentals of the petrochemical industry - Kuwait, 1978, (OAPEC).

JICA