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THE CHEMICAL INDUSTRY: DEVELOPMENT POSSIBILITIES IN THE CARIFTA REGION

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TABLE OF CONTENTS

THE CHEMICAL INDUSTRY:
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INTRODUCTION

The Caribbean Free Trade Association (CARIFTA) includes among its members Guyana (formerly British Guiana), Jamaica, and Trinidad and Tobago, and also the group of islands known as the Lesser Antilles,[1/] of which Barbados is the most prominent member because of the size of its population, while Grenada and St. Lucia are of secondary importance in this respect.

In 1968, a number of these islands signed an agreement setting up a common market [2/], which is open to the other members of CARIFTA.

The total population of these islands - English-speaking - was 4.5 million in 1969.

There is a very variable population density among the different countries, as the following figures show:

Country	Approximate population in 1969 (thousands)	Percentage of total	Approximate density inhabitants per km^2, 1969
Jamaica	1 958	42.9	179
Trinidad and Tobago	1 086	23.8	212
Guyana	732	16.0	3.3
Antigua	72	1.6	163
Barbados	252	5.5	586
Grenada	105	2.3	305
St. Lucia	113	2.4	183
Others	250	5.5	...
Total	4 568	100.0	17.8 [a/]

a/ Area average.

1/ The other CARIFTA countries are: Antigua, Barbados, Dominica, Grenada, St. Lucia, Montserrat, and the St. Kitts-Nevis-Anguilla group.

2/ East Caribbean Common Market Agreement: Antigua, Dominica, Grenada, St. Lucia, St.Kitts/Nevis; it also includes the Associated States of St. Vincent and Montserrat.

/In the

In the 1960s these countries began to diversify their economies, which are traditionally based on the export of raw materials and tropical products and on the valuable revenue derived from tourism in nearly all of them. Thus, recently a very active manufacturing sector has sprung up, designed not only to replace capital and consumer goods traditionally imported from the Commonwealth by local products, but also for the purpose of exporting locally made manufactures, chiefly to the United States, Canada and the United Kingdom.

The main sources of income in the area are as follows:

Oil and oil refining (Trinidad)

Bauxite mining and alumina production (Jamaica, Guyana)

Production and export of tropical products, coffee, sugar-cane, rum, etc.

Tourist industry (Jamaica, Barbados and Lesser Antilles)

The principal countries have varied national products: the following are the approximate figures for gross per capita income in 1967:

PER CAPITA INCOME (GDP), 1967

(US dollars)

Jamaica	426
Trinidad and Tobago	674
Guyana	271
Antigua	340
Barbados	361
Grenada	187
Weighted average per CARIFTA country	429

Source: "Final Report of the Industrial Development Mission to CARIFTA countries" (UNIDO, Vienna), p.6, table I.

Consumption of chemical products

The main components of the market for chemical products in the CARIFTA countries are final products, such as medicines, toilet articles and fertilizers. In addition, there are pockets of heavy demand for basic products for the alumina industry, especially in Jamaica, while Trinidad and Tobago export a substantial amount of ammonia and petrochemical raw materials.

Import statistics are the chief source of basic data for an evaluation of the market for chemical products. Apart from the petrochemical products

/exported by

exported by Trinidad, the major part of local production is devoted to processing (detergents, paints, pharmaceutical goods, pesticides) or final products such as soap and matches.

Foreign trade data are too general[3/] to allow an exact estimate to be made of demand, and at the same time there is a re-export trade between the islands, particularly important in the case of Trinidad and Jamaica, which helps to distort the data for real consumption. As to local production, all that can be done is to use very fragmentary data for a small number of products on the larger markets of the area; it has been possible to calculate approximate production values and to make provisional estimates of the consumption of soap, detergents and paints on this basis.

Generally speaking, the level of apparent demand for chemical products is influenced by the high rate of consumption of imported toilet articles, which is probably due to the tourist industry in the case of Jamaica, Barbados and some of the smaller islands.

The total value of the chemical products market was about 85 million dollars towards 1967; this is shown in table 1, which collates all information on foreign trade available at the time of the mission's visit, i.e., approximations of the value of local production based on local figures for the value and volume of chemical production and over-all estimates for the group of smaller islands. In the latter, it was recognized that gross imports were virtually equivalent to apparent consumption, since the small local production of final goods is offset by possible re-exports, which are also small.

For a population of 4,373,700 in 1967, average per capita consumption stood at about 19.20 dollars.

There is a heavy participation on pharmaceuticals, toilet articles and cleaning specialities, which in 1967 accounted for 30 per cent of the imports of chemical products[4/] of the four countries referred to in table 1.

3/ Data usually include Section 5 (SITC) and certain other plastic and rubber items, when information is available (particularly in the case of Jamaica and Trinidad).

4/ Jamaica 23 per cent; 30 per cent in Trinidad, with a per capita consumption of 3.3 dollars; 35 per cent in Guyana, and 55 per cent in Barbados, with a per capita consumption of 12 dollars.

/Table 1

Table 1

PRODUCTION OF AND DEMAND FOR CHEMICALS IN FOUR CARIFTA COUNTRIES, 1966 - 1967

(Thousands of US. dollars)

	Net imports		Estimated local production		Exports of local products		Production used locally		Apparent demand	
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967
Jamaica	29 156	29 867	8 300	8 800	5 176	5 420	3 124	3 380	32 280	33 247
Trinidad and Tobago	18 994	20 506	41 000	52 800	36 243	47 556	4 757	5 244	23 751	25 750
Guyana	11 754a/	11 950a/	1 300	1 400	...	...	1 300	1 400	13 054	13 350
Barbados b/	4 836	5 400*	250	370	171	293	79*	77*	4 915	5 477
Subtotal	64 740	68 373	50 850	63 370	41 590	53 269	9 260	10 101	74 000	77 824
Rest of the area b/ c/	5 800a/	6 300a/	-	-	-	-	...	...	5 800	6 300
Total	70 540	74 673	...	...	...	...	...	...	79 800	84 124

* Estimates owing to lack of precise statistical data.

a/ Recognized as equivalent to gross imports; little or no re-exports.

b/ Section 5 (SITC) only.

c/ The apparent consumption of Antigua appears abnormally high for a population of 70 000 and is probably explained by the large number of tourists purchasing goods (cosmetics, pharmaceutical goods, etc) on the island; per capita consumption stands at 26 dollars compared with 12 for Montserrat and 8 for St. Kitts/Nevis. The average per capita consumption of chemical products for the other islands (360 000 inhabitants) was taken to be 10 dollars.

/Re-exports of

Re-exports of imported chemical products in 1966 were valued at about 745,000 dollars in Barbados, 960,000 dollars in Trinidad and Tobago, and 157,000 dollars in Jamaica.

Exports of local products[5/] to the countries of the region were as follows in thousands of dollars:

	1965	1966	1967
From Jamaica	1 105	2 908	2 565
From Trinidad and Tobago	7 651	6 758	7 863
From Barbados	-	190	-
Total	8 756	9 856	10 628

This intra-regional trade should expand with the help of a specialization policy discouraging the unplanned establishment of plants producing similar types of goods in each of the countries signatory to the free trade agreement. It may be noted that in 1966 exports of local manufactures to the area represented only 23.7 per cent of total chemical exports; in this the influence of Trinidad and Tobago is apparent, for of its large share - valued at 36.2 million dollars - of total exports, 81.4 per cent went to countries outside the region.

JAMAICA

The striking thing about chemical imports into Jamaica is the high proportion despite their low unit value destined for the alumina industry.

The value of chemical imports (section 5 of the SITC) amounted in recent years to 8 per cent of the total goods imported and comprised the following major categories, representing two-thirds of the total:

5/ Chiefly paints, detergents, cosmetics and small quantities of fertilizers. Any product which has gone through at least one stage of processing is considered to be of local origin.

	1966	1967
	(Thousands of dollars)	
Total imports - SITC Section 5	27 121	28 484
1. Medicinal and pharmaceutical products	3 926 (14.5 per cent)	3 947 (13.9 per cent
2. Toilet, polishing and cleaning preparations	3 628 (13.4 per cent)	2 670 (9.4 per cent
3. Inorganic and organic products	6 036 (22.3 per cent)	7 935 (28 per cent)
of which caustic soda:	2 814[a/]	3 763[b/]
4. Fertilizers	4 480 (16.5 per cent)	4 304 (15.2 per cent

a/ 63 265 tons, at an average price of 44.50 dollars.

b/ 97 879 tons, at an average price of 38.45 dollars.

Between 1963 and 1967 imports increased from 19.6 to 28.5 million dollars, with an annual average increase of 7.8 per cent.

The imports reflect the relative absence of local manufactures - up to 1966 - of rubber, resinous and polymeric (fibre) goods. This situation improved towards 1967-1968 with the beginning of the tyre and plastic goods industry; thus, the proportion of imports of rubber and polymers in the structure of national demand for chemical products may be expected to grow.

With regard to exports, essential oils (lime oil, pimento oil and others) should be mentioned, although they are not in themselves chemical products. In 1966, the value of exports - not including re-exports - amounted to 5,176,000 dollars, 61 per cent of this total corresponding to the division comprising essential oils, toilet goods, polishing preparations, etc. (3,157,000 dollars), while the share of paints, varnishes and similar products was 24 per cent (1,257,000 dollars). In 1967, exports amounted to 5,420,000 dollars, showing an appreciable increase in pharmaceutical products and fertilizers, as opposed to a drop in essential oils and toilet goods.

According to local statistics, production reached about 8,800,000 dollars in 1967, with a predominance of soaps (8,000 tons) and paints (a little over 1 million gallons).

/It is

It is interesting to note that the production of alumina sulphate (3,000 tons in 1968) can easily be increased owing to the availability of large amounts of sulphuric acid when the construction of a new 100-ton/day plant is completed.[6/] Thanks to the advantage of having a local supply of alumina (not calcinated), it will be possible to increase the range of exportable derivatives. Besides sulphate for industrial use further viable lines of production based on local alumina are chlorides, hydroxides and other salts used either in the chemical or the pharmaceutical industry. Output of sulphuric acid - mainly for the manufacture of alumina sulphate - amounted to 2,500 tons in 1966, 4,000 tons in 1967 and 5,500 tons in 1968.

The production of alumina comes close to one million tons a year and is at present in full development; to the two plants now in operation, at Kirkvini and Ewarton (ALCAN), will be added 900,000 tons' capacity by the end of 1969 (Alparts: Reynolds - Kaiser - Anaconda), 360,000 tons in 1970 (ALCOA) and 360,000 tons in 1971 (Revere). With these, the total capacity to be expected by about 1971/1972 will be around 2,700,000 metric tons a year.

Production of refined salt (technical sodium chloride) was begun in 1969 using sea salt imported from Venezuela at a cost of 9 dollars a ton. Refined salt is needed for the regeneration of zeolites in the water-treatment units of the alumina industry.

The last important item in local production is essential oils, of which 183.8 tons were exported in 1966, to a value of 801,000 dollars (4,360 dollars per ton).

The possibility of refining glycerine locally might be considered since solutions of crude glycerine are produced as by-products of the soap industry.

There is also a series of manufacturing activities related to the chemical industry: formulation of detergents and cleaning preparations, polishes, etc., formulation of insecticides for household use, processing of plastic materials (there were more than six processing plants by 1965), manufacture of medicines and a large number of laboratories producing perfumes and other cosmetics.

6/ The installed capacity for alumina sulphate is around 10,000 tons a year.

/Most of

Most of these para-chemical manufactures are developed by subsidiaries of foreign firms (United Kingdom, United States).

The caustic soda problem

The demand for chemical products used in the manufacture of alumina is basically for caustic soda, in a proportion of 80 to 90 kg per ton of alumina. Other elements and reagents are required in smaller amounts for water processing (amongst them hydrochloric acid and technically-pure sodium chloride). Should the production forecast for Jamaica materialize by 1972, caustic soda demand will as a result reach a volume of close to 250,000 tons. 7/

The effect of variations in the price of caustic soda on the export price of alumina - estimated at 70 dollars per ton - is reflected in the following costs per metric ton:

Cost of caustic soda (dollars per ton)	Effects per metric ton of alumina (dollars)	(per cent)
45 a/	4.05	5.8
61 b/	5.50	7.9
75 c/	6.75	9.6
95 d/	8.55	12.2

Note: Caustic soda valued in accordance with: (a) Average cost of imports in Jamaica (1966); (b) List price in the United States for a 50 per cent solution; (c) Quoted price, lowest (France) in Europe for 98/99 per cent solid caustic soda (March 1969); (d) Quoted price, maximum (Germany), for the same period (March 1969).

It can be observed that a 100 per cent increase in the price of alkalis would raise the cost of producing alumina by around 4.5 dollars per ton, i.e. a 6 per cent increase.

The relation between the valorization of chlorine and the cost of electrolytic caustic soda, both locally produced, can be examined on the basis of the following parameters, which are in line with the present real situation:

- Salt cost: 15 dollars per metric ton, likely to fall to 9 dollars
- Electric energy cost: 1.5 US cents/kWh.

7/ If the demand from Guyana and Surinam is added to this figure, the total would be around 300,000 tons a year.

/Initial manufacturing

- Initial manufacturing range covering between 140,000 and 175,000 tons of caustic soda a year.

- Direct labour cost at 0.60 dollars an hour.

- Interest on capital: 6 per cent and pay-off in 10 years (not including taxes).

A preliminary estimate, based on the above parameters, gives the following relation between the price of chlorine and the cost of producing caustic soda:

Price of chlorine	Cost of caustic soda	
	a/	b/
105 - 110	60	51
94 - 100	70	61
87 - 95	75	66
72 - 78	90	81

a/ With salt at 15 dollars.

b/ With salt at 9 dollars.

Lastly, an evaluation of how the above prices would affect the selling price of an important chlorine derivative, such as vinyl chloride monomer (VCM), gives the following results:

PROBABLE PRICE OF VINYL CHLORIDE MONOMER (VCM)
(US cents/pound)

Production scale	20,000 tons/year		50,000 tons/year	
Price of chlorine in dollars per ton	75	100	75	100
Cost of ethylene (US cents per pound)				
4	7.3	8.2	6.3	7.15
5	7.8	8.65	6.75	7.65
6	8.3	9.1	7.2	7.95

/It can

It can thus be concluded that a valuation of chlorine at 100 dollars per ton - which would make caustic soda at a price of about 60 to 65 dollars per ton - would result in a price for monomer equal to or below 8 cents per pound, for manufacturing scales of 50,000 tons a year of monomer, or somewhat lower if ethylene can be obtained at 4 cents per pound. It is considered that 8 cents per pound of monomer would be a competitive price compared with present imports in this area.

These costs take into account the possible purchase of ethylene at 3 to 3.5 cents per pound in the Gulf Zone of the United States or its production, by means of naphta cracking, at a cost not higher than 6 cents per pound in a plant with an annual capacity of from 60,000 to 70,000 tons.

In conclusion, consideration might be given to the establishment in the area of a plant producing electrolytic caustic soda on an initial scale of not less than 100,000 tons a year. The feasibility of such an undertaking must be assessed, however, through a prior study of the following aspects:

1. Availability of salt at a price c.i.f. the electrolytic-plant of less than 15 dollars per ton, if possible, preferably close to 10 dollars per ton.

2. Potential of the nearby markets to absorb the production of either chlorine, at a minimum f.o.b. price of 80 dollars, or vinyl chloride monomer (VCM) at 8 cents per pound, f.o.b. Only 34,000 tons of chlorine are needed to obtain 50,000 tons of vinyl chloride; therefore, production of vinyl chloride monomer will not constitute a big enough outlet to absorb a production of some 140,000 tons of chlorine a year, simultaneously obtainable with 160,000 tons of caustic soda.

Lastly, the possibility of exporting chlorine to markets on the Gulf coast should be considered. The quoted prices for chlorine towards the end of 1968 were around 74 dollars per ton, delivered to customer; it would, therefore, be useful to ascertain the feasibility of such exports and to evaluate an acceptable f.o.b. price for chlorine, excluding the costs of transport, storage and marketing.

Although the manufacture of caustic soda by the chemical method, starting from sodium carbonate would eliminate the problem of chlorine supplies, there seems to be little possibility of arriving at a cost lower than 100 dollars per ton, starting from a carbonate costing from 48 to 50 dollars per metric ton, a difficult price to obtain in any event in a local plant with a capacity of less than 300,000 tons a year, which would have to be able to depend on salt supplies at no more than 3 to 4 dollars

/per ton

per ton.[8]

In response to this complex situation, some groups of entrepreneurs have sprung up who are prepared to invest in the establishment of caustic soda production in Jamaica.[9] No firm decision to invest appeared to have been taken by the beginning of 1969, and the results of preliminary studies carried out locally were not yet known. Suggested alternatives made vague references to the export of surplus chlorine, either unprocessed or previously converted into ethylene dichloride,[10] for which purpose ethylene would have to be imported, as mentioned earlier in this report.

TRINIDAD AND TOBAGO

Trinidad and Tobago shows a favourable foreign trade balance for chemical products from 1964/65 onwards, owing to the rapid growth of exports of ammonia and petroleum derivatives such as aromatic hydrocarbons, propylene tetramers and normal paraffins.

Between 1965 and 1967, the over-all figures for section 5 of the SITC were as follows:

Year	Imports		Exports	
	Thousands of dollars	Percentage of total imports	Thousands of dollars	Percentage of total exports
1965	20 325	4.4	21 169	5.3
1966	19 318	4.2	33 761	8.0
1967	20 761	4.9	45 581	10.3
1968	17 900[a]	4.3	40 803	9.0

a/ Provisional figures.

Local production is still not too diversified and corresponds mainly to exported items (ammonia, urea, ammonium sulphate and some petrochemicals). To this must be added increasing local activity in formulations (detergents, paints, medicines) and the production of soap, matches and other similar

8/ Costs estimated in "La industria de álcalis sódicos en América Latina", (E/CN.12/804, May 1968) pp. 32 to 36.

9/ In particular, the "Phelan Sulphur" group.

10/ Intermediate product used in the production of vinyl chloride.

/products in

products in amounts which are difficult to assess precisely and whose value, on the basis of the 1967 figures, does not exceed 5 million dollars.

The little data available on production by local industry give the following figures:

	1966	1967	1968
Soap (tons)	5 600	5 756	5 870
Matches, gross	320 070	333 610	...

No figures are available for the production of paints nor for detergents formulated from imported active ingredients. There are four enterprises which make up and sell drugs and proprietary medicines.

Sulphuric acid production is related to the manufacture of ammonium sulphate, and has a capacity of 208 tons per day.

It may be estimated that local demand for chemical and parachemical products amounts to approximately 25 million dollars (25 dollars per capita), which is relatively high compared with the average for Latin America and is accounted for by the high share in imports of such final consumption goods as pharmaceutical products, cosmetics and other toilet goods, which in 1967 were valued at 6,297,000 dollars, or one-third of imports under the head of chemicals.

Imports of chemical products themselves are characterized by small volume and often relatively high cost, partly owing to the small scale involved. In view of this last aspect, which is common to the whole area, it would seem advisable to take a regional approach to trade by facilitating bulk purchases, perhaps at lower c.i.f. prices, for subsequent distribution among the different CARIFTA countries. The table below lists selected chemicals of high import value and indicates the quantity of each actually imported:

TRINIDAD AND TOBAGO: IMPORTS 1968

Product	Average cif value (dollars/ton)	Quantity (tons)	Main area of origin and local unit price
Caustic soda	70.60	3 298	UK (66) USA (117) Netherlands (27)
Sodium carbonate	68.80	2 271	USA
Sulphuric acid	265.00 a/	27.2	UK
Hydrochloric acid	227.00	37.1	UK (206) Netherlands (807) others (160)

a/ Probably special quality (reagent, battery fluid, etc). Exports amounted to 566 tons at 83.40 dollars per ton f.o.b.

/Petrochemical production

Petrochemical production

Trinidad has two petroleum refineries processing crudes, 32 per cent of which are of local origin. Capacity is 300,000 barrels per day at one plant (Texaco: Pointe à Pierre) and 80-85,000 barrels per day at the other (Shell: Point Fortin). The former used to produce basic petrochemical products, now outmoded, which have given way to other products as external demand has become saturated or as price became less favourable; this was the case of dodecylbenzene[11/], the production of which ceased some years ago.

Under the system of giving a five to ten year "tax holiday" on certain items the trend among producers appears to be towards ceasing production of those products whose exemption from taxation is coming to an end. This will probably happen with aromatic hydrocarbons and fairly soon with cyclohexane. On the other hand, the production of new items aimed at satisfying fast-growing external demand is expanding.[12/]

Currently, production is concentrated in two catalytic reforming plants (platforming), one of which mainly produces high-octane gasolines, while the other feeds a Udex plant separating aromatics (toluene, benzene). Recent platforming capacity (1969) was 15,000 barrels per day and aromatics extraction capacity was 3,300 barrels per day. The major part of exports[13/] go to the United States market under long-term contracts.

As to new projects, thought is being given to the possibility of establishing a natural-gas processing plant (Gulf of Paria) using C_4 fractions (butenes-butadiene), as the probable outcome of agreements to exploit natural gas in conjunction with other producers.

Recent capacity and production of petroleum derivatives are as follows:

11/ Produced during the 1940s from imported benzene. The drop in prices for dodecylbenzene, and its recent replacement in the detergents field, led to discontinuation of production. At present, propylene tetramer, the raw material for dodecylbenzene, is being exported.

12/ This has been the case of normal paraffins in recent years.

13/ Texaco Export Company.

/Capacity

	Capacity (Barrels per day)	Production (Thousands of barrels per year) 1966	1967	1968 (January-June)
Cyclohexane	960	172.6	240.5	104
Propylene tetramer	300	...	23.6	13.7
Benzene	3 300	160.7	211.8	110
Toluene		298.1	408.6	186.9
Di-isobutylene	...	34	40	27
Normal paraffins	1 500	649	491.8	287
Xylenes	...		15	7

At the beginning of 1969, f.o.b. export prices were as follows, compared with United States posted prices:

	F.o.b. export price		United States posted price at end 1968
	dollar/barrel	cent/gallon	cent/gallon
Cyclohexane	9.66	23	24
Propylene tetramer	12.66	30.1	...
Benzene	7.77	18.5	25
Toluene	5.04	12	24
Di-isobutylene	8.08	19.2	a/
Normal paraffins	10.17	24.2	b/
Xylene, mixed	6.90	16.4	23 - 26

a/ 8 cents per pound, approximately 38 cents per gallon.

b/ 4.5 cents per pound, approximately 32 cents per gallon.

It may be concluded that activities are mainly geared to satisfying marginal demand in the United States market accessible to the Texaco group, which owns a large refinery at Port Arthur, Texas, and is associated with the United States Rubber Company.

Normal paraffins

Normal paraffins is the term used to describe a cut of gas oil-kerosene containing linear hydrocarbons - i.e. unbranched - with a number of carbon atoms ranging from ten to eighteen, preferably around fourteen. It is obtained through

/a separation

a separation process (molecular sieves) that ensures a content of straight paraffins of over 95 per cent.

Exports of normal paraffins from Trinidad have increased since 1965, and amounted to 649,150 tons in 1966 and 491,758 in 1967. Production capacity depends on the availability of certain primary distillation fractions from crude oil.

The average value of these exports in March 1969 was 10.17 dollars per barrel f.o.b., or approximately 70 dollars per ton.

A proportion of 96 per cent of normal paraffins is used in the manufacture of linear-type alkybenzenes[14/] which have been replacing traditional dodecylbenzene[15/] in United States and European markets in the manufacture of the more common detergents.

Towards the end of 1968, United States production of alkylbenzenes stood at approximately 650-700 million pounds per year (300,000 tons), and exports over the first six months of the year amounted to 143 million pounds (65,000 tons) at an average value of 8.97 cents per pound (198 dollars per metric ton). It is estimated that linear-type alkylbenzenes account for some 550 million pounds (3,250,000 tons) of the total, with dodecylbenzenes accounting for the majority of exports. The most important producers are: Monsanto Co., Continental Oil Co., and Union Carbide Corp., whose individual capacity is some 150 million pounds (68,000 tons) within a total capacity that very nearly meets the demand. One of the smallest capacity plants known is situated in Buffalo, N.Y. (Allied Chemical Corp.) and produces 20 million pounds (9,000 tons) per year.

Replacement of dodecylbenzene in the manufacture of detergents to obtain bio-degradability was presumed to be complete in the United States market by 1965. The increase in demand from 1968 onwards is not expected to exceed 3 per cent annually. On the other hand, it is expected that the trend towards replacement in the other international markets will have the result of prolonging foreign demand, which will be covered by the rapid expansion of production in other countries with, therefore, no need for current exports from the United States to increase. Added to this is the fear that linear-type alkylbenzenes will be displaced by even more degradable materials, such as alcohol sulphates and alkenyl sulfonates.

14/ Linear alkylate.

15/ Dodecylbenzene, or branched-chain alkylates.

/The production

The production of linear alkylbenzenes requires some 0.72 tons of normal paraffins and 0.30 to 0.35 tons of benzene per ton of product.

The market price for alkylbenzenes is similar (1968) to that of dodecylbenzene and fluctuates around 10 cents per pound (220 dollars per ton).

Considering the current price for benzene (25 cents per gallon) and normal paraffins, basic raw material cost would be approximately 96 dollars per metric ton (24 for benzene and 72 for the linear hydrocarbon),[16/] evaluating normal paraffins (C_{10} to C_{18}) at 4.5 cents per pound, which was the list price in the United States market in 1968. In consequence, the value added on both raw materials - of petrochemical origin - is approximately 120 dollars per ton of detergent alkylate, out of which probably some 30 to 40 dollars would go on capital costs (amortization, maintenance and interest), and the remainder would cover other operating costs (labour, energy, reagents, etc.) and include any additional margin of profit.

As a first approximation, it can be stated that the processing of 10,000 tons (22 million pounds) of normal paraffins[17/] would produce 14,000 tons of detergent alkylate at an export value c.i.f. place of destination (10 cents per pound) of 3 million dollars; some 3,200 tons of benzene would also be used.[18/]

The possibility of attracting firms interested in exporting detergent alkylate in addition to covering the potential demand of CARIFTA, which can be estimated at some 6 million pounds by 1975, can be entertained and should therefore be included among the activities that it would be desirable to establish in the area, probably in the neighbourhood of plants producing benzene and normal paraffins.

As regards the market for normal paraffins, it should be noted that the production capacities recorded in the United States chemical and oil industries[19/] are far in excess of demand. For a nominal capacity of 1,015 million pounds (460,000 tons), effective demand was estimated at

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16/ Linear paraffins.

17/ Valued at 990,000 dollars, United States list price, and at 770,000 to 800,000 dollars, Trinidad export price.

18/ About 178,000 dollars' worth at the present export price.

19/ Oil, Paint and Drug Reporter, February 1968.

/515 million pounds

515 million pounds (233,000 tons) in 1968, and not expected to rise beyond 580 million pounds. Similarly, the availability of benzene in the industrialized countries is not a limitation, so that it may be concluded that the presence of raw materials at normal cost, although a positive factor, is not alone sufficient reason for the installation of an exporting plant. To this must be added, wherever possible, reasons of geographic proximity - i.e. lower transportation costs - or commercial reasons arising from the previous establishment of a firm in the foreign market it wishes to supply, and also the possibility of displacing the use of dodecylbenzene in order to preserve water resources in the large urban agglomerations.

On the other hand, access to the external market is far from easy for a new producer in the field of synthetics, since he is faced with a price policy very much akin to dumping, and with market allocation practices among the groups which dominate the world market; these practices effectively force developing countries to establish common protective tariffs and sign market or economic integration agreements enabling them to begin manufacturing such products with the certainty that an adequate market is available (Latin American Free Trade Association (ALALC, Central American Common Market, and indeed CARIFTA).

Natural gas

Trinidad has a fairly abundant supply of natural gas, obtained from the oil fields in the gulf of Paria and, in part, from land reserves. The situation as regards natural gas and its exploitation is summarized in the following figures:

		Millions of cubic metres
- Reserves, proven (1966)[a/]		56,600
- Exploitation in 1968		429.0 (100%)
- Destination in 1968:	for fuel	159.5 (37.2%)
	for industrial processes	30.0 (7.0)
	re-injected	60.3 (14.0)
	vented	179.2 (41.8)
- Probable exploitation in 1969		1,000 to 1,300

Source: Ministry of Industry, Commerce and Petroleum.

a/ Not including recent off-shore discoveries.

/Among the

Natural gas is used as a fuel chiefly for the production of electric power in Port-of-Spain and for cement manufacture. The existing 22-inch gas pipeline from Penal would be inadequate in the short term and its capacity should be doubled by 1973. The gas for industrial processes is that used in the manufacture of ammonia (FEDCHEM, Grace).

The chief components of natural gas are as follows:

Methane	87.7%
Ethane (C_2)	5.6%
Propane (C_3)	4.5%
Isobutane	1.1%
Normal butane	0.3%
High-boiling fractions, Hydrogen, etc.	0.8%

The price of natural gas is estimated at 17.5 Trinidad and Tobago cents [20] per thousand cubic feet, in Penal. The price of natural gas for thermal use fluctuates between 25 and 40 T.T. cents; for the cement industry it stands at 26 T.T. cents; and for ammonia production it varies between 24 and 26 T.T. cents.[21]

Present resources will continue to cover the demand originating from the production of ammonia and electric power and from minor uses as fuel, without large surpluses remaining.

Nevertheless, the confirmation of recent off-shore discoveries (as a result of prospecting by the Pan American Trinidad Oil Co.) and their eventual development on a big scale mean that they will have to be worked on a profitable basis. Cost will probably be kept within the present limits of between 12 and 18 United States cents per thousand cubic feet, but it remains to be seen whether this will be low enough for some of the possible uses, among which the following may be mentioned:

(a) Separation of C_2 + components to obtain ethylene. The gas at present being exploited apparently contains 11.5 per cent of hydrocarbons in a C_2 - C_4 range - a proportion which, if found in the new deposits, would justify the installation of a separation plant. The residual processed gas would then be used in one of the following ways.

20/ Approximately 10 US cents.

21/ Approximately 14.4 US cents

/(b) Production of

(b) Production of electric power on a large enough scale for its cost to be attractive to the electrolytic industry (caustic soda and chlorine) or for the reduction of alumina from other countries in the area. In the first case a cost of 0.5 to 0.6 United States cents per kWh of electric power should be sufficiently low while in the second case the cost would have to be less than 0.4 cents per kWh. The problem of salt supply - and its cost - will play a decisive role in the first case.

(c) Expansion of ammonia production. The drawback to this idea is the marked decline in the world market price of ammonia, particularly as a result of increasing over-capacity. It is doubtful whether foreign firms would be interested and such a project would have to be considered in the framework of local participation - probably State participation through the national oil company - along lines similar to those of recent projects carried out in other areas (SAFCO in Saudi Arabia, for example).

(d) Exports of liquid natural gas (LNG) to countries lacking adequate supplies. Although technically feasible, this would involve heavy investment on which only minimal profits could be expected[22/] in view of the heavy impact of the capital costs entailed in the construction of terminals and in transport costs.

Ammonia and nitrogenous fertilizers

This is one of Trinidad and Tobago's major industrial activities. Begun by Grace in 1959 (ammonia and urea), the industry was enlarged in 1962-1964 and again in 1966-1967.[23/] Its nominal capacity is at present 1,320 tons of ammonia per day (436,000 tons per year), using natural gas, and its recent output was 245,000 tons in 1967 and 230,000 in the first half of 1968.

22/ Approximately 1.5 Trinidad and Tobago cents net, in royalties, per thousand cubic feet, according to negotiations under way in 1969 between Pan American Trinidad Oil Co. and groups interested in the project (United States). Some 8.5 million cubic metres of off-shore gas per day could be produced, if the deal went through.

23/ The first unit produced 95 tons per day, the second - with reciprocal compressors - 615 tons per day, and the third - with centrifugal compressors - 750 tons per day.

/There are

There are two urea units, one producing 150 tons per day with recycling (Stami Carbon), and the other 70 tons a day without recycling of ammonia. Two-thirds of this is exported to the United States and most of the remainder to Central America and the Caribbean. The state of the world urea market led to the shutting down of a similar plant in Puerto Rico and another in Aruba [24] producing 200 tons per day. Ammonium sulphate is also being produced, but in decreasing amounts.

Altogether, investment amounts to approximately 70 million dollars.

Ammonia production benefits from a ten-year tax holiday due to end in 1973. The transport cost of exports, which are shipped in tankers,[25] is around 6.50 dollars to the United States and 10-12 dollars to Europe. In 1969, the selling price of ammonia at the port of destination was estimated at less than 40 dollars and prices as low as 34 dollars were recorded in Europe.[26]

Prospects of increasing ammonia production thanks to the new deposits of natural gas which have just been discovered are dimmed by the poor state of the world market, as noted in the analysis of the possible uses for the gas. The technical efficiency and specifications of the third ammonia plant should lower operating costs sufficiently to make it competitive with modern plants producing 600 to 1,000 tons per day; the same cannot be said of the other two, whose costs may well price them out of the market. Consequently, these may have to be shut down in the near future, thereby reducing total capacity to only 225,000 tons per year. Even the urea units are approaching a capacity judged to be uneconomic compared with current scales of production, reaching 1,000 tons per day and over.

GUYANA

Imports of chemical products in 1967 totalled 19,114,000 Guyanese dollars - approximately 11,950,000 United States dollars - of which the principal items, amounting to 80 per cent of the total, were as follows:

24/ Netherlands Antilles.

25/ Two tankers with a capacity of 9,300 short tons, and one with a capacity of 14,000 short tons.

26/ The lowest price recorded was for sales in the Gulf zone, at 26 dollars per short ton, f.o.b.

/Thousands of

	Thousands of United States dollars
- Caustic soda, 22,500 tons	1,350[a/]
- Other organic and inorganic chemicals	1,825
- Drugs and pharmaceutical products	2,368
- Toilet soaps, perfumes, cosmetics, etc	1,890
- Fertilizers	2,190

Source: Foreign Trade Yearbook.

a/ Average cost, 60 United States dollars per metric ton.

Imports of plastic manufactures totalled around 350,000 dollars and insecticides and similar products 460,000 dollars.

Recent imports of caustic soda (1968) - as 50 per cent solution - amount to the equivalent of around 27,000 tons a year, at an approximate local price of 36 United States dollars per ton, which differs from the average shown for 1967.

Chemical production is mainly in the form of soaps and detergents, matches, paints and some pharmaceutical goods. The production figures for 1967 and 1968 are as follows:

	1967	1968
Laundry soap, ton	1,720	2,000
Detergents, ton	180	643
Paints, thousands of gallons	114	128

Local production of pharmaceutical specialities in 1967 amounted to 1,384,180 Guyanese dollars (approximately 813,000 United States dollars) in value. The relatively high volume of soaps and detergents, amounting to nearly 2.7 kg. per capita in 1967 and 3.7 kg. in 1968 - not including imports - should be mentioned. As from 1963, manufacturing activities developed in the fields of plastic products, tyre retreading and others which will gradually extend the range of chemical products imported by Guyana, although for the time being its production of the above-mentioned items is very small. According to local statistics, chemical production was 1,300,000 United States dollars in 1966.

The fact that industrial development is still in its early stages in Guyana together with the limitations of a small market [27/], would not appear to

27/ A population of 700,000 in 1967; gross income around 300 United States dollars per capita.

facilitate the development of chemical activities much beyond the range already indicated. Guyana's Development Corporation is studying the possibilities of exploiting certain raw materials which seem to have commercial possibilities judging by the quality and quantity available (kaolin for the porcelain industry and clays used as filler in several manufactures such as paper, rubber, etc.) and is investigating some promising indications of chromite-type mineral deposits which have not yet been fully evaluated. Furthermore, considerable interest is at present being shown in the possible local production of raw materials such as fats and oils (coconut oil) which are still being imported; the production of rice oil and the development of coconut oil production are being considered by the Development Corporation.

In the sphere of oil refining, the establishment of a very small plant with a capacity of not more than 7,000 barrels a day is at present being contemplated.[28/]

It is not known whether there are any salt deposits in Guyana, and the production of salt from sea water - through solar evaporation - is not feasible owing to the dilution of the coastal waters by the large rivers and to prevailing climatic conditions.

BARBADOS

As the country's principal economic activities are agriculture and tourism, there is practically no demand for industrial chemical products, except those required for the manufacture of soaps (1967 production : 935 tons, valued at about 210,000 United States dollars). To this must be added a small glycerine output, declining between 1962 and 1967 from 58 to 32 thousand gallons (a little over 100 tons), and an oxygen/acetylene plant which supplies the neighbouring markets.

The most abundant natural resource is limestone, which is part of the island's geological composition and is exported inter alia to Trinidad and Guyana.

The trade in chemical products showed imports of almost 4,836,000 United States dollars (1966), after deduction of re-exports (745,000 United States dollars). As in the other countries in the area, finished products like

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28/ Mention should be made of the case of Barbados, which has a refining capacity of 2,000 barrels per day.

/pharmaceutical products

pharmaceutical products (1,614,000 United States dollars), toilet goods and fertilizers (960,000 United States dollars) predominate. Nevertheless, there are some exports of local manufactures, such as soaps (45,000 United States dollars) and pharmaceutical products. In all, apparent consumption can be estimated at approximately 20 United States dollars per capita, part of which represents consumption by the floating population (90,000 tourists a year).

As the local market is insignificant,[29/] the establishment of local activities, such as the compounding, mixing and packing of pharmaceuticals, cleansers and other products is heavily dependent on strong fiscal incentives and credits, similar to those found in other CARIFTA countries.

SOME OTHER MANUFACTURING ACTIVITIES

Besides the comments that have been made in connexion with the main countries in the area regarding production of caustic soda, nitrogenous fertilizers and petrochemical, a few general suggestions must be made as to the steps these countries might take in order to make the best use of their new industrial structure. The most important of these is the creation of a regional technical body which would bring together the directors of the several Industrial Development Corporations existing in the area for the sole purpose of establishing a single location for each new manufacturing industry in accordance with a joint policy of complementarity and specialization for all the member countries of CARIFTA. A body, or Regional Industries Committee of this kind would carry out market research and feasibility studies aimed at promoting investment, establishing limits beyond which national incentive policies must not go, and specifying in each case the most suitable location from the point of view of the general interest.

In the light of the existing market and future trends, there are a number of chemical activities whose implantation could be justified over the next five years. For example, the region would be an acceptable market for the following products, among others:

29/ A population of 252,000 in 1969.

/Alkyd resins

- Alkyd resins (glycero-phthalic and others)
- Thermosetting resins of the urea-formaldehyde and phenol-formaldehyde type
- Formaldehyde, originally manufactured from imported methanol
- Emulsions of the vinyl acetate type, for the preparation of adhesives and bases for paint
- Oils of vegetable origin for industrial use
- More highly processed essential oils and spices.

There is also a parallel and urgent need to solve the problem of the supply of such raw materials as sodium chloride on a regional basis and to explore the feasibility of creating salt-pans on the coasts of Jamaica, Trinidad (west coast) and other islands of the Lesser Antilles.

Other activities mentioned in previous studies or discussed during the visit of the Mission are briefly referred to below.

Furfural

As sugar is produced in the region, it is possible to consider the use of bagasse as a raw material, either for pulp and paper or for furfural, an aldehyde employed as an intermediate in certain chemical manufactures or as an auxiliary in the preparation of mineral lubricating oils. There are sufficient quantities of bagasse in Jamaica and Trinidad to warrant the establishment of this industry, though only on a relatively small scale; however, only in Trinidad are the sugar mills sufficiently close together.

Previous feasibility studies[30] have determined the possibility of producing furfural from bagasse in Trinidad at an approximate cost of 8 to 9 United States cents per pound, which has been considered too high wholly to justify its production. Nevertheless, the prices quoted towards the end of 1968 were over 14 United States cents per pound, as follows:

	United States cents per pound
- United States, f.o.b. factory, east	14.5
- United Kingdom, delivered, 5 tons	14.95
- Belgium	19.1
- France, delivered, 5 tons	17.1
- Germany " "	19.8
- Italy " "	21.9

30/ "Report on feasibility and market study for production of furfural" (EC 132/226 TRTO), May 1967.

/There would

There would undoubtedly be considerable interest in exploring this possibility further; all that would be needed would be to bring the estimates in the 1967 study up to date in line with local cost factors, and to review current raw material availability and transport conditions.

Pesticides

The consumption of pesticides (insecticides, fungicides and herbicides) is estimated at around 4.5 million dollars for the whole area, of which approximately 50 per cent corresponds to Jamaica.

The area's demand for active elements is relatively small and scattered among several products. In 1967 it was estimated at 12 tons of chlorinated products, 18 tons of organic phosphates and around 20 tons of arseniates; to this must be added 10 tons of copper salts employed in the preparation of fungicides and some 50 tons of prepared nematicides. The largest volume is represented by spray oils used in sugar-cane and banana plantations, amounting to some 6,000 tons.

One of the problems which to a certain extent affect the future development of this activity is the absence of special solvents - not produced because of the small demand - and of adequate locally produced containers (especially coated metallic drums and domestic containers). In spite of this, there are several firms engaged in the bottling, packing and distribution of pesticides and, in some cases, preparing the blends of active material with carriers of local origin (kaolins and limestone, paraffin solvents).

Although the manufacture of active substances does not seem attractive at present, the production of solvents and propellants would seem justifiable following a preliminary evaluation of the area's potential demand.

Soda ash

The main reason for including soda ash among the projects considered under national development programmes is the great demand for caustic soda in the alumina industry. In the absence of a sufficient market for chlorine and its derivatives[31] and of low-cost energy resources (electric power),

31/ Apart from the strong competition in the international market for these products.

/the electrolytic

the electrolytic process - which appears simple at first sight - is very difficult to apply. Consequently, the manufacture of caustic soda by chemical means, using soda ash, has been contemplated.

Nevertheless, the resource situation is not very favourable, primarily because of the scarcity of salt, the principal raw material, which would have to be imported at considerable transport cost and would thus have serious repercussions on production costs (1.6 tons of salt per ton of soda ash). To this must be added problems such as that of refrigeration water, which plays a vital role in the manufacturing process, since great quantities are required and sea-water is resorted to in certain cases. However, the latter must not exceed an acceptable maximum temperature of 22-23°C, at the risk of incurring serious loss of efficiency in carbon dioxide absorption and sodium chloride conversion. In the case of the Caribbean, the average sea-water temperature is around 26-27°C, and supplies of fresh water suitable for refrigeration appear to be somewhat limited. Finally, the two other items that weigh heavily on production costs, fuel and limestone, are not found together in any of the countries which might be interested in producing soda ash (Jamaica has excellent lime deposits, while Trinidad has low-cost natural gas and other fuels).

Aluminium

Although this report is not intended to cover a subject which does not properly belong to the field of the chemical industry, as is the case of alumina reduction, certain facts should be mentioned that might contribute to the formulation of research lines for future action in this sphere.

It would appear that the energy supply is the main problem in establishing plants for reducing alumina to metal in the Caribbean area. Studies have been carried out with regard to the utilization of the rich potential hydroelectric resources in areas such as Guyana, and Jamaica's interest in the generation of electric power of nuclear origin for the same purpose is well known. It is also known that the manufacture of aluminium consumes around 17,500 kWh per ton and, at the cost commonly accepted by the great producing centres of 3 to 4 dollars per thousand kWh, this represents some 62 dollars per ton of metal produced. The circumstances that have suggested the advisability of further research in this field include, first of all, the studies carried out by Reynolds around 1961 in connexion with

/the establishment

the establishment in Kuwait of an aluminium plant employing electric power of thermic origin produced from natural gas. Investment in this project amounted to some 42 million dollars for a capacity of 50,000 tons of aluminium a year. It is obvious that, if the product were manufactured on a sufficiently large scale, the cost of electric power supplied by low-cost natural gas[32/] could be very low and therefore attractive for the reduction of aluminium. In the case of a 50,000-ton aluminium plant, the energy requirement is about 120,000 kW[33/]. In brief, this seems to suggest not only that hydroelectric or nuclear possibilities should be considered but that a more detailed investigation should be made of the possible economic advantage of using the natural gas available in Trinidad.

CONCLUSIONS

One of the problems confronting the CARIFTA countries in their efforts to achieve a greater interchange of products stems from the similarity in their production structures (sugar, bauxite and alumina, bananas, light finishing and assembling industries, such as clothing and garments). This situation forces them to compete with each other in a series of consumption products for which the total size of the available market is very small, and to depend on identical exports to provide the greater part of their foreign export income.

The advisability of diversifying new industrial activities and establishing a pattern of specialization for them has to be considered if we bear in mind that, in many cases, a regional market of 4 to 5 million persons is the optimum size for obtaining competitive costs. This is not feasible on local market scales, which vary from less than 1,000 inhabitants to between 800,000 and 1 million (in Trinidad and Tobago, and Guyana), and 2 million in Jamaica.

There is little possibility of planning the specialization and diversification of numerous activities which are already established in one or two countries, and even less if these activities are dependent on a single resource which is available in all the CARIFTA countries. On the other hand, the industrial activities (usually processing industries) which import their raw materials (generally intermediate products) and do not present locational

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32/ As in the case of Trinidad if the potential importance of recent off-shore discoveries along the west coast is confirmed.

33/ Roughly equivalent to a consumption of one million cubic metres of gas per day.

/advantages of

advantages of any importance could be installed in one of the countries to cover the demand of the CARIFTA countries as a whole. Unfortunately, this is not the present trend in several activities - related to the chemical sector - producing consumption goods (soap, detergents, paints, cosmetics and cleaning specialities); there are several firms manufacturing these goods, not only in the area, but even in a single country. Although this results, at the beginning at least, in healthy competition, that advantage will soon be offset by the narrowness of the market, and when it is divided between several manufacturers, the scales of production are far below the economic minimum. Unless a deliberate agreement is reached at a regional level for the programming of this type of manufacturing from a strictly economic point of view a situation will very soon arise where protection is provided for industries which are duplicated in the CARIFTA countries and have production scales that do not allow them to compete with the products imported from preference areas, much less to export.

On the other hand, the foreseeable fast expansion in the manufacturing industries related to construction and tourism (equipment), and the rapid development of the textile and clothing industries, footwear manufacturing, food processing, etc., will gradually create a demand for intermediate goods and auxiliary products originating in the chemical sector. At the same time, over the next decade this incipient demand (covered at present by imports) will, of itself, call into being many small firms that will take advantage of the vast system of facilities and incentives existing in the area; and the result will be many small enterprises of low economic efficiency. In our opinion, the most urgent thing is not to define these possible future activities, but to establish the principle of "regionality", which would involve agreeing to the location of industries in specific countries, thus preventing the atomization of the market among several producers. Competition from foreign producers should provide sufficient pressure to prevent monopolies with all their disadvantages, even with the establishment of a common protective tariff, which would generally have to be higher than the present 10 to 20 per cent customary in the area.

/It is

It is undoubtedly more feasible to arrive at an agreement tending to preserve the market at the present stage than in the future, when the proliferation of small manufacturers in all these countries will make it a practical and institutional impossibility.

Furthermore, there is a factor which to a certain extent jeopardizes the rational distribution of new activities in a regional pattern. This is the lack of connexion between the basic resources available (petroleum and its direct derivatives, alumina, limestone, and other agricultural and chemical raw materials) and the structure of the newly-born industry, which is dependent on imports of raw materials from more industrialized countries, especially intermediate and final products (in the chemical sector) used in the manufacture of detergents, paints and cosmetics, or the semi-elaborated plastics and the textiles required by the clothing industry. In other words, it is not yet possible to discern in the present structure a demand for basic and intermediate goods of industrial origin, since it comprises only the last stages of the manufacturing process. This is a natural result of the market limitations, and it will require a joint effort and effective programming to accelerate the move towards a more integrated industrial structure which can close the gap between final demand and the production of raw materials.

The alternative, consisting in the development of basic industrial activities with a view to producing for export outside the area goods with a greater unit value than those now produced, may have some possibilities, but it cannot be adopted throughout the area. This a possibility when primary products not available in abundance in the rest of the world are to be found in the Caribbean (bauxite and alumina), or when the Caribbean produces basic products easily transported in bulk for which there is a permanent marginal demand in the technologically advanced countries (Trinidad and Tobago's hydrocarbons and ammonia, for instance). Nevertheless, it is difficult to apply this solution in the next stages of manufacturing also for several reasons; one of these is that it is doubtful whether a producer would find any financial advantage in producing goods for export to highly competitive and protected markets - often saturated - when their manufacture requires a high level of technical knowledge and efficiency and high capital density and the raw materials are to be found on practically identical terms in any industrialized country. In such cases any locational advantages there may stem mostly from local sacrifices (tax exemption policies and other incentives); and this invalidates the original reasons for wanting to initiate such activities, since their effective contribution to the local economy is much lessened.