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ASBESTOS CEMENT PRODUCTS INDUSTRIES IN NORTH AFRICA

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CHAPTER I

ASBESTOS AND CEMENT PRODUCTS

<u>Industry description</u>

1. Asbestos cement products, as their name implies, are produced out of cement mixed in water with asbestos (approximately 80 per cent cement and 20 per cent asbestos). The two principal asbestos cement products are:

- asbestos cement sheets (corrugated or flat);
- asbestos cement pipes.

2. Asbestos cement sheets are used mainly in corrugated form. The sheets are an excellent roofing material and are considered the best insulator against heat. Too, they are practically immune to the action of water. Flat sheets are also used but to a lesser extent, in wall panelling.

3. To arrive at the market demand for asbestos cement roofing is not a simple task. This product tends to replace and to compete, in price or in quality, with the more traditional roofing materials. These are the thatched roof, in traditional building, the corrugated or flat galvanized iron or aluminium roofing sheets in the monetary economy, and other kinds of roofing materials such as the clay-burned tiles and the various slates and shingles still in use.

4. The thatched roof, as well as the tiles and shingles, do not present any serious competition to asbestos cement roofing. The thatched roof is the first structural and functional element to be replaced from its subsistence origin by industrial materials. The tiles and the shingles brought over by the Europeans require high workmanship and complex construction increasing their competitive limitation.

5. For competition on roofing, there are the corrugated or flat galvanized iron sheets, the flat or corrugated aluminium sheets, the asbestos cement corrugated sheets and the <u>in situ</u> cast concrete roof.

6. From the commercial point of view, the galvanized iron sheets are the cheapest. Next in price are asbestos cement sheets, and the most expensive are the aluminium sheets. The concrete roof cast in situ cannot usually compete in cost with the others mentioned, but in most cases it could not be replaced, due to the required specification either from the structural or functional point of view (mainly in multistorey buildings).

7. From the functional point of view, asbestos cement has all the properties required for roofing (see annex). However, in comparison with the other metal sheetings, asbestos cement is the heaviest per square metre and has to bear the highest transportation cost. Too, there is the hazard of a certain percentage of breakage due to improper handling during the transportation or installation processes. These hazards are unknown in galvanized iron sheets, but although the cheapest and having the largest share of the market, these have a very low resistance to corrosion and must be replaced after comparatively few years.

8. In conclusion, we see that the three dominant roofing elements which compete on the market each have attractive properties offsetting their handicaps. Good salesmanship, service and organization could do much to change their market share. This is sometimes more than the price factor or the technological properties.

9. It would be appropriate to mention here new developments such as the various corrugated plastic and fibre-glass sheets which are beginning to appear on the market. They are not yet competitive either in price or in function, but their development is challenging. Nevertheless, we shall overlook this factor on the assumption that till 1980 their impact will not yet be felt and that the market be left to the three well established roofing elements mentioned above.

Asbestos cement pipes

10. Asbestos cement pipes are produced in any desirable length up to six metres and in diameters up to 500 millimetres. They are used mainly for water supply, for handling other non-corrosive liquids, for gas supply, and for many other uses.

11. Among the many advantages of asbestos cement pipe, we may stress their accurate shape, a smooth inner surface, good chemical resistance to many corrosive liquids or soils, their complete immunity to stray electric currents or corrosion, and their light weight and easy installation. They can be painted inside and outside for auxiliary protection when needed.

12. Not all pipe of other materials presents competition to the asbestos cement pipes, each type of pipe having special advantages and disadvantages as well as a different price. Each serves its own range, but a great deal of development is possible.

13. The other types of pipes which may compete on partial ranges of the demand are as follows:

- Cast iron pipes, which are quite heavy;
- Steel pipes, which are the most compatible;
- Red clay pipes which are porous and have a very short life - are used mainly for drainage;
- Stoneware pipes which stand most of the aggressive chemicals but are expensive;
- Ordinary concrete pipes which are cheap, not too strong or resistant but could be hand-manufactured;
- Reinforced concrete pipes which require a more elaborate manufacturing process, are strong and more resistant than the ordinary concrete pipe, more expensive but still cheaper than asbestos cement pipes, although heavier;
- The plastic pipe which has appeared on the market only recently and does not yet answer all the technological and economic requirements to be competitive. Nevertheless, the impact of plastic technological possibilities should not be overlooked when projecting the market demands. Any projection for pipe market in 1975-1980 should leave for plastic pipes a considerable share.

The asbestos fibre raw material

14. Asbestos is the only natural mineral that occurs in a fibrous form. It is composed of silicon, oxygen, water and magnesium (sometimes also sodium and iron). The two most important types are the chrysotile asbestos and the crocidalite asbestos.

15. In trade and industry, asbestos is classified in seven groups, according to the length of the fibres (the Canadian classification). The longer fibres are used mainly in textiles, while the medium length is used in asbestos cement products (Canadian group 4, "shingle-stock").

16. Different types, in various lengths, are blended together in order to arrive at the desired performance at the cheapest price. The appropriate formula is a result of great practical know-how, but it is usually developed by the suppliers who may not have available all the desired types and lengths.

17. The mixing of cement with asbestos is based on the same idea of reinforced concrete. It produces a new material which combines the high compressive strength of cement with the high tensile strength of asbestos fibres.

18. The U.S.S.R. is the world's leading producer of chrysotile asbestos. It and Canada are the main producing countries of asbestos in the world. South Africa and Rhodesia possess great deposits of asbestos, and a short fibre type is also drilled in Swaziland. Asbestos deposits have been developed in the Sudan and its exploitation may begin shortly.

19. Known world reserves are said to be adequate for at least 25 to 30 years, but the demand for the asbestos cement fibre is increasingly strong and during recent years, production has been sold one year ahead.

20. Further occurrences of asbestos mines, hitherto unexplored in Africa, are quite promising. Exploration is likely to proceed intensively under the incentive of world market pressure.

The process and alternative techniques of production of asbestos roofing sheets

21. The asbestos fibre is usually found together with hard rock and must be separated by a grinding process. In the raw materials market, asbestos may be purchased in unmilled form or ready milled into separated fibre. The second form, the ready-milled, although more expensive is eventually more economical through the savings on milling equipment and electric power. Only in the case of local availability of raw asbestos-milling equipment might it prove more economical. In any case, either it needs a fluffing device or a grinding mill to reach the necessary opening of the fibre. This affects the proportion of asbestos to cement, thus making production more economical.

22. Fibre is drawn in the required weighed quantity and further opened by the principle known as hydro-disintegration. It is then pumped into mixers where it is thoroughly mixed with the cement and water into a form of slurry. There are a number of different mixing methods. The quantity and consistency of mix is regulated as per requirement. The slurry is fed into a holding tank, from where it replenishes the level of raw materials in the cylinder vat of a so-called "Hatschek" machine.

23. A thin layer of the slurry is picked up by sieve cylinders and transferred to an endless felt under pressure of couch rolls. The felt moves forward, away from the Hatschek machine, over a vacuum box where most of the water is removed. The film is ultimately transferred to an accumulator roll where desired thickness of sheets is built up under pressure. The felt requires replacement approximately every 125 operating hours and costs approximately US$400. Hatschek machines are available in different sizes. The smallest has one cylinder vat, but the larger may have three or more. The number of cylinder vats contributes to the time it takes for the desired thickness to build up. The difference might be three times as fast.

24. On attainment of required thickness, the sheet is cut off from the accumulator roll and allowed to pass into the corrugating machine. Cutting may be done by hand, reducing production speed. However, when done by automatic cut-off machinery it is possible to utilize the full potential output.

25. Corrugating may be done manually (by two men stationed on the opposite sides of the take-off conveyor) or by mechanical devices which pick up the flat sheet off the conveyor and corrugate it automatically. In the choice between manual or automatic corrugation it is not only the speed of production that matters, but also the strength of the finished product which in some cases may make it possible to use shorter-fibred asbestos - resulting in some saving in the cost of raw materials.

26. The corrugation and the setting of the sheets are made in steel forms which are comparatively expensive. Some factories use asbestos cement made forms, but the excessive oiling needed caused serious operational difficulties. The sheets remain in the forms to allow them to attain the initial set. This, if done in open atmosphere requires some 8-10 hours. Then the sheets can be moved from the forms, which are cleaned and oiled before re-entering the production cycle again.

27. The sheets, after being removed from the forms, must be allowed to cure in accordance with the normal requirement for cement (i.e. under normal conditions - 28 days). Curing is often done by lowering the sheets into large concrete water tanks. The curing process, at natural temperature, ties up large amounts of floor space, working capital and additional labour in piling and unpiling the sheets. The alternative process is by steam curing, which might take as little as three hours. Steam curing, on the other hand, requires additional equipment, but could take place at night (an advantage only in small factories where the "Hatschet" machine works only during the day shift).

28. A more modern way of curing (but one requiring higher investment) is with pressure autoclaves in which sheets are steam cured at very high temperature. These not only permit very rapid curing but also

make it possible to substitute ground quartz sand for around half the cement. It, of course, results in an important saving in raw material cost.

29. Trimming the edges a second time, after the sheets have reached their final hardness, results in a better looking product. This is necessary in a competitive internal and external market. This can be done by expensive automatic trimming machines, but it can also be done satisfactorily by an electric hand-tool equipped with a carborandum saw on a special trimming jig.

30. To conclude, we see that alternatives exist in manufacturing, resulting in a cheaper or better product with higher or lower investments:

1. unmilled versus milled asbestos fibre;
2. higher degree of opening of fibre with a more rapid production;
3. slower or faster "Hatschek" machines;
4. manual or mechanical cutting;
5. manual or mechanical corrugating (also longer or shorter fibre);
6. steel or other forms;
7. steam or atmospherical curing;
8. pressure autoclaves with replacement of part of cement through quartz;
9. manual or automatic trimming.

The choice between the alternatives will be dictated by the size of the market, the availability of raw materials, the available funds for capital investment or other aspects of the local situation.

The alternative production process of asbestos cement pipes

31. Alternative production processes differ mainly in the initial pipe forming stage, the loosening system and the curing process. In the pipe formation stage there may be differences depending on the mixing, and moisture extracting machinery.

32. The loosening of the pipe from the case or mandrel may be done by hydraulic pressure or by a patented electrolytic loosening system.

33. A radical difference is in the curing system. One is the ordinary water curing where the pipes are kept under water sprays for some fifteen days and are ready to use twenty-eight days after production. The other system is steam curing in autoclaves. This not only makes stronger pipe, ready for shipment within forty-eight hours of production and thus relieving working capital, but it enables the replacement part of the cement by ground silica and consequent savings in raw material costs. The autoclaving process contributes to the chemical stability of the product by significantly reducing the free lime content from the range of 13-18 per cent of the non-autoclaved products. Free lime is the component which is susceptible to leaching and first attacked by sulphate and acid environments. Thus, although autoclaving requires additional initial investment, the result will give a better product more quickly and at lower cost.

34. In the process, portland cement is mixed in water with short asbestos fibres. This slurry is spread over a steel rotating core inside which a vacuum is created. The slurry sticks to the cylinder where it dries quickly under the air circulation caused by the vacuum. During the drying process another cylinder gives the slurry the form of a pipe and assures the regularity of the weight.

35. The crude pipe, on its core, is extracted from the machine and introduced into a hydraulic calender which exerts pressure on the pipes while again a vacuum is recreated inside the core. Thus, the pipes rapidly attain the necessary strength.

36. A hydraulic extractor or an electronic loosening system separates the pipe from the core and places it on an inclined drying table where it remains for twenty-four hours. Then the pipes are placed in containers which are immersed in water vessels where they are cured for a fortnight, gaining the necessary strength. Twenty-eight days are necessary for the pipes to reach the specified strength for use.

37. When silica is available and investment in autoclaves justified, the curing process is done by steam and the pipes may be ready for use, as has been explained above, within forty-eight hours of production.

38. The alternatives in supply of raw asbestos, whether in crude form or in a milled one, as well as the degree of opening of the fibres are the same as for the asbestos cement sheets.

World market situation for asbestos cement products

39. Information on world trade in asbestos cement products is incomplete. The available trade figures, given in table 1, cover mainly Western European countries and very few from elsewhere.

40. The largest importer of the countries shown is the Federal German Republic, with imports near hundred thousand tons in 1963. Second was the Netherlands with over 80,000 tons.

41. The largest exporter in 1963 was Belgium-Luxembourg with almost 216,000 tons. It is interesting to note that most big exporters are big importers as well. Examples are the Federal Republic of Germany with an export of 50,000 tons, or Italy which imported almost 16,000 tons while its exports reached 32,000 tons.

42. Due to costly transport, it is often more reasonable to import from a neighbouring factory abroad than to transport over long distance internally. It is also an easily re-exportable commodity in the trade transactions between countries.

43. Table 2 shows some of the trade figures of North African countries. It will be seen that Italy and the United Kingdom were large exporters into the sub-region, while Algeria and the UAR were exporting to some Mediterranean countries.

Table 1: Selected importer countries of asbestos cement products[1] in 1963

Country	Quantity tons	Value '000 US$	Cost price $/tons	Main provenance of imported goods
Belgium-Luxembourg	9,714	712	73.30	Netherlands, Denmark, France
France	18,388	1,318	71.68	Belgium, Luxembourg, Germany, Algeria
Federal Republic of Germany	98,203	9,477	96.50	Belgium, Luxembourg, Sweden, Austria
Italy	14,684	1,351	92.00	Yugoslavia, Belgium, Luxembourg
Netherlands	81,205	7,093	87.35	Belgium, Luxembourg, Germany
United Kingdom	24,357	2,324	95.41	Belgium, Luxembourg, France
Denmark	1,073	158	147.25	Belgium, Luxembourg
Norway	13,721	1,626	118.50	Denmark, United Kingdom, Belgium
Sweden	16,945	1,824	107.64	Belgium, Luxembourg, Denmark
Switzerland	3,594	428	119.09	Germany
Greece	4,438	345	77.74	UAR

1/ SITC number 661.83.

Table 2: Selected exporter countries of asbestos cement products[1/] in 1963

Country	Quantity tons	Value '000 US$	Unit price $/ton	Main destination
USA	3,719	1,608	43.24	India, Canada, Japan
Belgium-Luxembourg	215,851	21,082	97.67	Netherlands, Germany, USA, UK
France	39,188	3,242	82.73	Germany, UK, Vietnam Rep.
Germany	50,239	4,145	82.51	Netherlands, France Yugoslavia
Italy	32,484	3,146	96.85	USA, Tunisia, Fed. Rep. Malaya
Netherlands	8,197	567	64.17	Belgium, Luxembourg, Germany
United Kingdom	48,848	4,079	83.50	Sudan, Nigeria, Ghana
Denmark	10,050	1,192	118.61	Sweden, Norway
Japan	22,162	1,418	63.98	Ryukyu, Cambodia, USA

1/ Selection according to availability of information and to magnitude.

Table 3: Registered trade of asbestos cement products with countries of the North African sub-region in 1963

Exporting country	Importing Country	Quantity tons	Value '000 US$	Unit Price $ per ton
France	Algeria	1,055	113	107.11
France	Tunisia	2,093	176	84.09
Italy	Libya	1,237	133	107.52
Italy	UAR	612	59	96.41
Italy	Sudan	448	55	122.77
Italy	Tunisia	5,776	589	101.97
Belgium-Luxembourg	Sudan	772	65	84.20
United Kingdom	Sudan	6,010	375	62.40
UAR	Greece	2,688	164	61.01
Algeria	France	2,140	171	79.90

CHAPTER II

INPUT REQUIREMENTS OF ASBESTOS CEMENT ROOFING SHEETS PRODUCTION

General note

44. It is somewhat difficult to get the exact figures on input requirements from the past performance of existing factories, due to the fact that many of the factories produce, under the same roof and management, asbestos cement pipes as well as asbestos cement sheets. These differ in process, cost and price. The differences in proportions between the two products in the various factories result in different figures for input requirements. This is the reason why most of the input had to be based on estimates for projected factories. The performance of existing factories (which, as noted, are mostly mixed) are given as a guide to possible upper or lower limits.

Material inputs for current production

45. Asbestos fibre (chrysotile 4-5-6 group fibre) in quantities between 10-13 per cent of weight of finished product. Cost, of course, includes c.i.f. price at port of entry with addition of customs and the freight to the location of the asbestos cement sheet factory.

46. Cement (normal quality, slow-setting with a low hydration temperature) 70 per cent of weight of finished product. Cost includes the ex-factory price and the transportation to the asbestos cement factory.

47. Inert ingredients such as ground dried asbestos cement scrap, quarry-dust, cement plant, plus wastes or pulverized lava; the quantities depend on the quality of the material and its availability, could fluctuate by weight between 7-15 per cent of weight of product. The cost usually consists of the transport cost only, while sometimes it also includes the purchase price.

48. Water, non-saline free of acids desirable, saturated with limestone minerals. Direct consumption some 20 per cent of weight of product, but factory consumption of about 2-3 m^3 per ton.

49. Replacement of felts and cylinder screens ranges between $1.85 - $2.00 per ton of asbestos cement product.

50. Fuel, in case curing kiln is provided for; estimated at two litres per ton of product.

51. Electric power. Inputs depend on the type of machinery and the degree of mechanization. The requirements may range from 20 kWh per ton to 70-80 kWh per ton. It seems also evident from the report of the Dimatit factory in Morocco (see table 4) that with the increased output, a slight unit saving in consumption of power is possible.

Table 4: Inputs per ton production of asbestos cement products in the "Dimatit" factory in Morocco

	1962	1963	1964	1965	1966
Annual production in tons	19,688	25,077	24,322	25,375	18,216
Inputs per ton					
Cement - tons	0.697	0.672	0.674	0.638	0.707
Electricity - kWh	86.7	68.0	71.0	66.2	78.2
Water - m^3	3.4	2.6	3.2	3.12	4.4

Source: "La Société nord-africaine de l'Amiante-Ciment "Dimatit", 27 February 1967.

Management and labour

52. This varies according to the size of plant and to the production process. Roughly estimated: a small corrugated asbestos cement sheet factory, with a capacity of some 1,700 tons per annum proposed in the Central African Republic, has been planned to engage 26 persons (three management and 23 workers). This would produce 65 tons per annum per person engaged or 73 tons per annum per labourer. On the larger side, a 15,000 tons/year factory proposed in Kenya has been planned to engage

102 persons of which 71 are labourers thus producing 147 tons per annum per person engaged or 210 per labourer. The "Dimatit" factory in Morocco, producing sheets as well as pipe, in 1955 employed some 350 persons - with an output of more than 72 tons per person per year. Another factory, SICOAR, in Tunisia has been planned to produce 8,000 tons of pipes and sheets with 190 persons, that means 42 and 72 tons per person per year respectively.

53. Skilled labourers are 28-35 per cent of the labour force. The larger the plant, the lower their share. Semi-skilled: between 21 and 39 per cent, with the same growth trend as the skilled.

54. Unskilled labourers between 25 per cent in the smallest factories (1,700 tons per annum) and 51 per cent in the larger ones (15,000 tons per annum). The larger the plant, the larger their share.

55. The training of the supervisory staff should start some nine months before the plant begins to operate and continue for another three months in the factory.

56. The skilled labour has to begin training in another factory some six months before plant begins to operate and continue in the plant for another nine months.

Capital requirements

57. Fixed capital investment

Land, building and equipment was in the case of a small factory (1,700 tons per annum), $174,000 or some $100 per ton. For a larger factory, to produce 15,000 tons per annum, it was estimated to be $915,000 or only $62 per ton. For a still larger factory (Dimatit) with a capacity of 35,000 tons but with a mixed production of sheets and pipes, the fixed investments were $1,953,000 or $57 per ton capacity (present production being lower than the installed capacity). Of total fixed capital, the land and building account for some 20-35 per cent. The rest consists of investment in machinery, its transportation and installation.

58. If we increase the capacity of the small factory with another shift we could reduce the fixed investment to nearly $60 per ton. On the other hand, the large-scale factories with 15,000 tons per annum are planned on a three-shift basis. This, however, is not easily feasible, and planning should be on a two-shift basis. This means a higher investment per ton but also more sophisticated equipment, resulting in a much better product.

Working capital

59. Working capital is estimated to be $63 per ton per annum for the small plant but only $21 to $27 per ton for the larger one. It should be noted that in the calculation for the small plant, a raw material stock of eight months has been considered. The estimators for a large enterprise in Kenya provided for only two months stone. This leads us to conclude that a higher figure might also be considered in the case of larger enterprises. In estimating working capital needs, we can hardly take examples from one country and apply them directly to another, dependent as they are on the credit habits and supply conditions prevailing.

CHAPTER III

INPUT REQUIREMENT FOR ASBESTOS CEMENT PIPE PRODUCTION

Material inputs for current production

60. Asbestos fibre, chrysotile four group fibre and blue fibre, some 15 per cent of weight of finished product. Cost of fibre includes all charges until it is stored in the asbestos cement pipes factory.

61. Cement, cost as above specified, in quantity of 75 per cent by weight of finished product. If silica ingredient of the specified quality is provided, the cement quantity can be reduced to 50 per cent.

62. Silica ingredient up to 35 per cent by weight of finished product. Chemical and physical required properties: 99.7 per cent, 95.1 per cent of SiO_2 and 85 per cent passing through 200 mesh screen, etc.

63. Water, between 1.1 - 3.6 m^3 per ton, depending on the process and the capacity.

64. Power, 70-80 kWh per ton.

Management and labour

65. In the smallest enterprise (700 tons per annum in one shift) a managerial force of three persons and a labour force of 15 is enough. Doubling the output by creating two shifts will double the labour force and might add one to the managerial staff. The output per person engaged in such a factory could be of some 40 tons per annum. In larger enterprises, a hundred persons might produce 150 tons per annum per person. In still larger enterprises, with more than 25-30,000 tons per annum, almost the same labour force, might reach an output of 200 tons per person engaged per annum.

Fixed capital investment

66. The smallest pipe manufacturing enterprise, with a capacity of 700 tons, would require a fixed investment of some $500,000. Doubling or

tripling capacity, by utilizing two or three shift operation, would not require substantial additional investment.

67. Table 5 gives the investment required for two factories of asbestos cement pipe. The first is the smallest production unit, based on a one-shift production of 1,400 tons per annum. The other factory, which was planned to produce 37,500 tons a year in three shifts, has been adjusted to a two-shift basis (producing 25,000 tons) for comparison.

68. From the table we see that with a seven-fold investment, we can get an output 18 times higher. The fixed investment varies between $358 per ton for the small plant and $78 per ton in the larger unit. Buildings are 52 per cent of the fixed investment in the small unit but only 32 per cent of the total investment.

69. In the larger unit, buildings are only some 13 per cent of the total investment but some 18 per cent of the fixed investment. The rest is equipment, which in this case is much more sophisticated, having, for instance, autoclaves for steam curing, etc.

Table 5: Investment and investment per ton in two different sizes of asbestos cement pipes factories

US$

	Smallest feasible production unit 1/1,400 tons per annum (2 shifts)		Large capacity factory over 25,000 tons per annum (2 shifts)	
	Total investment	Investment per ton	Total investment	Investment per ton
Investment in buildings	260,400	186	356,000	14
Investment in equipment	241,000	172	1,606,000	64
Total fixed investment	501,400	358	1,962,000	78
Working capital	161,600	115	700,000	28
Total investment	663,600	473	2,662,000	106

Sources: For the smallest factory: "Possibilités d'industrialisation des Etats africains et malgache associés".

Production K. (adjusted for comparison from one shift production to two shifts).

For the large capacity: A proposal for the establishment of asbestos cement pressure pipe and asbestos cement sheet project for Kenya. Birla Brothers Private Limited. (Adjusted for comparison from three shifts production to two shifts).

70. Working capital, $28 per ton in the large-scale unit and $158 per ton in the small factory, is based on a two-month supply of local raw materials in the large plant and for twelve months in the smaller. This seems quite insufficient for large units in North Africa, where 4-6 months is more reasonable. This would raise the $28 per ton to $35 per ton.

Rates of depreciation

71. The depreciation rate in the asbestos cement industry does not divert from the ordinary accepted rates in the manufacturing industries of five per cent of the buildings (2) and 10 per cent for the machinery and equipment. The employed vehicles have a higher rate of 20 per cent to 33 per cent.

Variation in plant size and capacity utilization

72. In the prevailing conditions two working shifts at their full capacity could be considered as a maximum. Theoretically, and in specially good conditions of management, machinery and skilled labour, a three shift system could be possible, but it involves so many problems apart from the maintenance facilities, that in some cases it may require extra reserves of machinery.

73. The variation between one shift and two does not require any additional substantial equipment except for larger storage space as well as better curing facilities.

74. The variation in plant size and in capacity utilization, of course, have a bearing on production costs.

75. There is not enough detailed information available on the changed input and utilization of materials for units of different sizes. In this field of materials, advantage would mainly be through minimalization of waste.

76. Table 6 gives material and power consumption figures of one factory (Dimatit) during the last five years. A relation can be seen clearly between output and the "per unit" input. Still, we cannot take these figures as a rule because of the lack of a breakdown between the various products.

77. But if we may assume that the relation between the various products is more or less constant, we get with an increase of some 70 per cent in production utilization a decrease of 10 per cent in cement consumption, 20 per cent in power and over 60 per cent in water.

Table 6: Various inputs per unit for different levels of output
(Dimatit, Morocco – 1962-1966)

Yearly production output-tons	Cement kg/ton	Power kWh/ton	Water M^3/ton
18,216 (1966)	707	78	4.38
19,216 (1962)	697	87	3.38
24,322 (1964)	674	71	3.15
25,077 (1963)	672	68	3.12
25,375 (1965)	638	66	2.64

78. If we take projection figures of various planned factories, we notice that the variation in capacity and utilization does not affect labour costs as much for asbestos cement sheets as it does for asbestos cement pipe.

79. The share of labour cost in asbestos cement sheets varies between 12.5 and 15 per cent and is not substantially different in the large or small enterprise. This is true to the extent that there are no substantial changes in the process. Higher capacity, in the cases that were examined, shows a rise of 2-3 per cent of labour share in the cost but a doubling in the annual output per labourer.

80. On the other hand, with pipe, where mechanization has greater possibilities with larger scale, the cost of labour drops from 25 per cent to almost 10 per cent. The tonnage output per person engaged may reach 4 to 5 times that of the smallest unit.

81. The variation in capital costs per ton which accompany variations in plant size, is quite substantial. In a small-scale sheet factory, the fixed capital investment per ton per annum was US$103. In a small-scale pipe factory it even reached US$364 per ton per annum.

82. On the other hand, a large-scale pipe sheet factory required a fixed capital investment of only US$60 per ton and a large-scale pipe factory of only US$80 per ton. A mixed (sheet and pipe) factory on a large-scale in Morocco required only US$57 per ton capacity, but at the present capacity utilization of only 70 per cent (25,000 of 35,000 tons per annum) the fixed capital investment rises to US$80 per ton per annum.

83. As to the working capital, the difference is also quite substantial, ranging from some US$30 per ton in the larger establishments to nearly US$100 in the small ones.

CHAPTER IV

THE PRESENT SITUATION OF THE ASBESTOS CEMENT INDUSTRY
CAPACITY PRODUCTION, TRADE AND CONSUMPTION OF ASBESTOS CEMENT PRODUCTS

Algeria

84. The present capacity of the country's asbestos cement industries is 33,000 tons per annum (30,000 in Eternit-Algeria, and 3,000 in Zabana at Oran).

85. The output of these two factories was some 20,000tons in 1964 and over 21,000 in 1965. The detailed production of each of the factories, their utilization and employment is given in tables 7a and 7b. The value of this production has been estimated according to the FOB price of exports in 1963.

86. Table 8 shows the evolution of the production since 1960. It should be noted that in 1960 and 1961 production reached 37 thousand tons and was higher than the present total capacity. Consumption in 1961 reached an extraordinary figure of 40.5 thousand tons, which is more than twice the present output.

87. While imports have been decreasing since the pre-independence days, exports grew from 2,103 tons in 1961 to 3,168 in 1963.

88. As can be noted from table 7b the output per person employed in "Zabana", which is a public owned enterprise, is 4-5 times lower than the output of Eternit which is private owned and has ten times the former's capacity.

89. The total employment in this branch was some 730 persons directly employed. Domestic demand, which in 1961 reached the highest figure in the Maghreb of 40.5 thousand tons, decreased sharply in 1963 to 12.7 thousand tons.

Table 7a: Asbestos cement production and utilization in Algeria, 1964 and 1965

Enterprise	Capacity	Production in tons 1964	Production in tons 1965	Degree of utilization 1964	Degree of utilization 1965
Eternit	30,000	17,093	18,608	56.97%	62.02%
Zabana	3,000	2,620	2,705	87,33%	91,50%
Total Algeria	33,000	19,713	21,313	59.43%	64.55%
Value of production a/ US$		1,645,000	1,833,000		

a/ The average 1963 FOB value of US$86 per ton.

Source: Les matériaux de construction (La statistique de production) Ministère de l'industrie et de l'énergie, Algérie.

Table 7b: Asbestos cement, employment and productivity in Algeria, 1964 and 1965

Plant	Place	Employment 1964	Employment 1965	Ton per person employed Private	Ton per person employed Socialist
Eternit	Algiers	450	405	37	46
Zabana	Oran	280	320	9.3	8.2
Total		730	725	27	27

Source: Les matériaux de construction (La statistique de production) Ministère de l'industrie et de l'énergie, Algérie.

Table 8: Evolution of asbestos cement gross output in Algeria

TONS

Product	1960	1961	1962	1963	1964	1965
Asbestos cement	37,357	36,167	10,564	14,581	19,713	21,313
Index	100	98	28	39	53	57

Source: Les matériaux de construction (La statistique de production) Ministère de l'industrie et de l'énergie, Algérie.

90. One factory, DIMATIT, has operated in Casablanca since 1956. Its installed capacity is 35,000 tons per annum and utilization is some 70 per cent. All of the inputs, except for asbestos fibre, are purchased locally (wages, 42 per cent; materials of local origin, 40 per cent and the imported asbestos fibre 18 per cent).

91. Some 50 to 60 per cent of the production during the early sixties was exported. Sixty per cent of the export, by weight, was in corrugated sheets, mainly to African countries. The main export markets for asbestos cement from Morocco are Senegal, Ghana, Ivory Coast, Nigeria and France.

92. In 1966, export declined to 30 per cent of production, probably a main reason for the fall of production to 18,000 tons per annum.

93. It is notable that no significant quantities of asbestos cement products were exported to the neighbouring North African countries until 1965. In 1965 exports of asbestos cement pipe to Tunisia were some 910 tons.

94. The highest production figure, 25,400 tons, was registered in 1965 and paralleled the highest export figure, 15,000 tons. The highest local consumption, 16,000 tons, was registered in 1963 but then dropped to 10,310 tons in 1965.

95. Production of pipe grew more than 10 per cent between 1965 to 1966. The production of sheets fell by almost 50 per cent during the same period, being another reason for the fall in production by weight (from 25,000 tons in 1965 to 18,000 tons in 1966).

96. The gross output of the only factory in Morocco, Dimatit, is given in table 1 M, together with the production value as estimated by the FOB export price of each year. This export price is influenced by the ratio between the quantities of asbestos cement pipe, the price of which is substantially higher (by 30-40 per cent), and the quantity of asbestos cement sheets.

97. Value added. The intermediary inputs are given as 58 per cent of the ex-factory cost. If we assume that taxes, depreciation and overheads (which were not included in the rest of 42 per cent given as salaries and wages) to be some 10 per cent on top of the ex-factory cost, we

get for the inputs: 58 : 1.10 = 53 per cent, which leaves 47 per cent for the value added.

98. Manpower. The 353 employed in 1965 have remained constant for 1966, although production declined. Sixty were technicians and managerial staff (43 of them foreign expatriates), while the rest, about 290 were workers were of the various skills as well as the unskilled.

Tunisia

99. Tunisia has only recently begun producing asbestos cement products in an 8,000 tons per annum capacity unit, SICOAC (6,000 tons pipes and 2,000 tons sheet). No production data are as yet available.

100. Consumption, which peaked in 1964 with 13,000 tons, has been wholly imported. The major part of imports (60 per cent) came from Italy, a quarter of the import was from France and the rest from Algeria (1,800 tons or some 13.5 per cent) and Europe.

Libya

101. There is no production of asbestos cement in Libya. Asbestos cement consumption, which tripled from 3,723 tons in 1964 to 12,998 in 1965, was imported mainly from Lebanon (some 67 per cent), from Italy (some 11 per cent), from Yugoslavia (9 per cent) and the rest, in smaller quantities, from Japan, Czechoslovakia, the United States and Belgium. No imports were registered from any African country.

Sudan

102. Sudan has not been producing any asbestos cement products. Recently, some asbestos layers have been manufactured, but it is still far from industrial utilization.

103. The country's demand has had to be satisfied by imports. As figures show, in table 1, consumption fluctuated between 6,000 and 9,000 tons (disregarding the 1964 figure of 18,000 tons which must be qualified as well as the 1965 figure of less than 1,000 tons which is also not representative).

104. According to the 1960-1962 figures, the majority of asbestos cement products were pipes. These reached 84-70 per cent of imports, while the rest was asbestos cement sheets. This correlates with the tendencies of the ten-year plan, setting priorities for agricultural irrigation schemes.

105. The main exporters of asbestos cement products to Sudan were Yugoslavia, Italy, Czechoslovakia and the United Kingdom. The UAR has had a share of some 10 per cent in pipe in 1960 and of more than 60 per cent in sheets in 1962. During the recent years the UK's share has grown substantially (to some 90 per cent in 1963 and 76 per cent in 1964). The UAR's share in imports which decreased in 1964 to 5 per cent regained its traditional 10 per cent in 1965.

United Arab Republic

106. The UAR has production capacity of 40,000 tons of asbestos cement pipe and of 10,000 tons for sheets and accessories. Projects have been developed to expand the present manufacturing units to 59,000 tons/year.

107. The UAR has become a large exporter of asbestos cement products, exporting almost 18,000 tons in 1963. The main export markets were Greece, Ghana and Kuwait.

CHAPTER V

METHODOLOGY OF PROJECTING THE SUPPLY AND DEMAND FOR ASBESTOS CEMENT PRODUCTS AND THE LOCATION REQUIREMENTS

108. In the annex of the construction paper, the expected demand for the various building elements is stated.

109. These figures can be converted into the basic components and the respective building materials.

110. Example: in Algeria in 1970 according to table 5 A, the total expected roofing demand amounts to 1,090,000 m^2. From the same table we find that asbestos cement corrugated roofing is expected to take 20 per cent of this demand, equal to 218,000 m^2. Assuming that a square metre of corrugated roofing of asbestos cement sheets has a net weight of 14.4 kg, we get a demand of 3,139 tons.

111. In the same way, we assume that flat sheets for walling will present a demand of 1,350 tons and find from table 5 A the expected tonnage of pipe, 16,650 tons. The final demand for asbestos cement products will thus be 21,139 tons for that year.

112. In using this demand figure, one must bear in mind that other alternative materials are competing for this same market. These may satisfy part of projected demand, if asbestos cement of the right quantity or quality is not available.

113. As mentioned, meeting the possible demand depends also on successful marketing and on governmental policies and priorities.

114. Our projection of demand is based on the presently known technologies and may be relied upon for the next decade. However, we must be more careful in our projects for the more distant years, because

new technologies (mainly in the plastic field) are likely to emerge and eventually distort the structure of the projected market distribution expressed in table 4 of the construction paper annex.

115. In estimating output in the local production, we must assume more than 80-85 per cent utilization of installed capacity, which in itself is a commendable performance.

116. We may assume that some 15-20 per cent of production will be directed to exports (Morocco was exporting 30 per cent of its production in 1965). But this, of course, is intended only for the big producers whose capacity is higher than domestic demand (e.g. Algeria and Morocco).

117. Countries which do not have such capacity and whose cement production does not cover their full domestic demands (i.e. Tunisia, Libya and Sudan) will have to rely partially at least, on imports.

Factors determining the location of asbestos cement products factories

118. Availability of a market. This, based on projected domestic demand and on expected export possibilities, has to be in the neighbourhood of the biggest urban centre, or in a location which has easy access to such centres.

119. Availability of raw materials

(a) Cement, as far as possible, in the neighbourhood of a cement factory. In case the country does not produce cement, it would be best to have the factory near a maritime port (also desirable for the asbestos fibre);

(b) Asbestos fibre, where this is not locally extracted and has to be imported, the best location to minimize the transportation costs;

(c) Water, normal drinkable water;

(d) Quartz, supply possibilities.

120. Favourable transport facilities, which are most important in heavy products as well as bulky raw materials. Therefore, the most suitable location is the one which has the following conditions:

- Maritime port facilities;
- Railway connections with possible siding;
- Surface road connections.

121. As most of the production processes require electric power, supply of such must be obtainable.

122. Manpower, highly skilled management and technical manpower, which in many cases is expatriate, needs suitable living conditions.

123. There has to be a reserve from which skilled labour, as well as unskilled can be recruited. In all the cases, training has to be provided during the "running in" period.

124. Summing up the requirements: we are looking for a location which will be in the neighbourhood of:

(a) an highly populated urban area;
(b) maritime port;
(c) rail head or railway line;
(d) main national roads.

125. Locations which would answer these four conditions will most probably have at the same time:

(a) raw material supply facilities;
(b) a large potential market;
(c) power supply;
(d) accommodations for expatriate personnel;
(e) manpower reserves.

126. Proposed locations for future factories of asbestos cement products are:

Algeria	:	Algiers, Oran; third choice Bonn;
Morocco	:	Tangier, Casablanca; third choice Agadir;
Tunisia	:	Tunis, second choice Sfax or Gubes
Libya	:	Homs (a possible small factory in Benghazi)
Sudan	:	Khartoum

Country: Algeria
Industry: ISIC no. 339
SITC no 661-83

ANNEX I

Table 1: Production, demand, employment and investments 1960-1980

	Units	1960	1961	1962	1963	1964	1965	1966	1970	1971-75	1975	1976-80	1980
1. Capacity	1000t	33	33	33	33	33	33	33	33	33-50		50-80	80
2. Gross output													
a. value	$1000	3183	3081	902	1243	1677	1813	—	2051		3660		6128
3 b. quantity	1000t	37.4	36.2	10.6	14.6	19.7	21.3	—	24.1		43		
3. Value added	$1000	1496	1448	424	584	788	852	—	964		1720		2880
4. Exports													
a. value	$1000	—	182	—	277	294	312	329	398		606		779
b. quantity	1000t	—	2.1	—	3.2	3.4	3.6	3.8	4.6		7.0		9.0
5. Imports													
a. value	$1000	—	727	—	133	133	133	133	161		214		321
b. quantity	1000t	—	6.4	—	1.2	1.2	1.2	1.2	1.5		2.0		3.0
6. Domestic demand (=2+5-4)													
a. value	$1000	—	3626	—	1099	1516	1634	—	1814		3268		5670
b. quantity	1000t												
7. Employment total, of which		—	—	—	—	730	725	—	786		851		1286
8. Fixed capital formation													
Gross	$1000	180	180	180	180	180	180	180	180	2080	260	3400	400
Net	$1000	—	—	—	—	—	—	—	—	1020	—	1800	—

Country: Morocco
Industry: ISIC no. 339
SITC no 66 183

Table 1 : Production, demand, employment and investments 1960-1980

	Units	1960	1961	1962	1963	1964	1965	1966	1970	1971-75	1975	1976-80	1980
1. Capacity	t1000	35	35	35	35	35	35	35	35	35+15	50	50+30	80
2. Gross output													
a. value	$1000	1373	1579	1352	1723	1668	1744	1249	2334		3707		5286
b. quantity	t1000	20.0	23.0	19.7	25.1	24.3	25.4	18.2	34		54		77
3. Value added	$1000	645	742	635	810	784	820	587	1097		1742		2484
4. Exports													
a. value	$1000	526.1	743.6	949.3	813.7	1052.3	1122.4	427.9	980.2		1052		1403
b. quantity	t1000	7.5	10.6	12.9	11.6	15.0	16.0	6.1	14		15		20
5. Imports													
a. value	$1000	21	11	11	21	11	—	—	107		321		321
b. quantity	t1000	.2	.1	.1	.2	.1	—	—	1		3		3
6. Domestic demand (=2+5-4)													
a. value	$1000	868	846	414	930	627	—	—	1461		2976		4204
b. quantity	t1000	12.7	12.7	6.9	13.7	9.4	9.4	12.1	21		41		60
7. Employment total, of which								353	600		860		1100
Technicians & Management								60	114		180		250
8. Fixed capital formation													
gross	$1000	180	180	180	180	180	180	180	180	1860	260	3320	420
net	$1000									900		1800	

Country: Libya
Industry: ISIC no. 339
SITC no 661-83

Table 1: Production, demand, employment and investments 1960-1980

		Units	1962	1963	1964	1965	1970	1971-75	1975	1976-80	1980
1.	Capacity	t1000						0-6	6	6-15	
2.	Gross output										
	a. value	$1000							680		1700
	b. quantity	t1000							6		15
3.	Value added	$1000									
4.	Exports										
	a. value	$1000									
	b. quantity	t1000									
5.	Imports										
	a. value	$1000	...	359	420	1466	1700		2030		2030
	b. quantity	t1000	3.4	3.6	3.7	13.0	15		18		18
6.	Domestic demand (=2+5-4)										
	a. value	$1000	...	359	420	1466	1700		2710		3730
	b. quantity	t1000	3.4	3.6	3.7	13.0	15		24		33
7.	Employment, total of which								150		300
8.	Fixed capital formation										
	gross	$1000							50		
	net							600		800	

Country: Tunisia
Industry: ISIC no. 339
SITC no. 661-83

Table 1: Production, demand, employment and investments 1960-1980

	Units	1960	1961	1962	1963	1964	1965	1967	1968	1969	1970	1971-75	1975	1976-80	1980
1. Capacity	t1000							8			8	8-15	15	15-25	25
2. Gross output															
a. value	$1000							41			55		103		172
b. quantity	t1000							6			8		15		25
3. Value added															
4. Exports															
a. value	$1000												140		210
b. quantity	t1000							-			-		2		3
5. Imports															
a. value	$1000	822	569	816	889	1375	636				64		848		224
b. quantity	t1000	7.0	5.9	8.5	8.4	13.1	5.9	3			6		8		4
6. Domestic demand (=2+5-4)															
a. value	$1000										1072		2441		2485
b. quantity	t1000	7.0	5.9	8.5	8.4	10.0 estimate	9.0	9			14		26		37
7. Employment, total of which								150			160		250		420
8. Fixed capital formation															
Gross	$1000							800	65	65	65		125		225
Net	$1000							800				800		1200	

Country: Sudan
Industry: ISIC no. 339
SITC no. 661-83

Table 1: Production, demand, employment and investments 1960-1980

	Units	1960	1961	1962	1963	1964	1965	1970	1971-75	1975	1976-80	1980
1. Capacity									15	15	25	25
2. Gross output												
a. value	$1000								1280	1280	2140	2140
b. quantity	t1000								12	12	20	20
3. Value added	$1000								600	600	1000	1000
4. Exports												
a. value												
b. quantity												
5. Imports												
a. value	$1000	622	641	631	397	1630	118	1600		860		1500
b. quantity	t1000	6.3	6.4	5.9	9.3	18.0	1.0	15		8		14
6. Domestic demand (=2+5-4)												
a. value	$1000							1600		2140		3640
b. quantity	t1000	6.3	6.4	5.9	9.3			15		20		34
7. Employment total of which									200	200	330	330
managerial and technical staff									60	60	100	100
Skilled labourers									80	80	130	130
Unskilled									60	60	100	100
8. Fixed capital formation												
gross	$1000									70	670	120
net	$1000								900	—	600	—

Country: Algeria

Table 2 : Distribution of gross output of industry ISIC No. 339 - Year 1964

Gross output supplied to:	Value 1,000 US$
Final destination, total	464
Consumption: a. private	80
b. public	90
Fixed capital formation	-
Exports	294
Intermediate destination, total	1,213
Ind. 0 Agriculture, etc.	90
39 Miscellaneous industries	20
4 Construction	1,103
Total gross output	1,677

Country: Morocco

Table 2 : Distribution of gross output of industry ISIC No. 339 - Year 1964

Gross output supplied to:	Value 1,000 US$
Final destination, total	1,222
Consumption: a. private	80
b. public	90
Fixed capital formation	-
Exports	1,052
Intermediate destination, total	616
Ind. 0 Agriculture, etc.	62
39 Miscellaneous industries	30
4 Construction	524
Total gross output	1,668

Country: Algeria

Table 3: Input structure of industry ISIC no. 339 - Year 1964

(in US$ 1,000)

		Absolute values		Input coefficients	
		Total	of which imported		2 as % of 1
0	Agriculture, etc.				
1	Mining and quarrying	231	224	138	97
20	Food manufacturing ind.				
23	Textile industry	40	20	2.4	50
25	Wood manufacturing ind.	20	10	1.2	50
32	Petroleum and coal prod.	10	10	0.6	100
33	Non-metallic mineral prod.	225	—	13.4	—
34	Basic metal industry	3	1	0.2	33
35	Metal products	20	10	1.2	50
36/37	Machinery	32	32	1.9	100
38	Transport equipment	32	10	1.9	30
39	Miscellaneous industries	20	—	1.2	—
4	Construction industry	10	—	0.6	—
5	Electricity, gas, water	40	10	2.4	25.0
62/63	Banking, insurance, etc.	10	—	0.6	
64	Real estate	10	—	0.6	
7	Transport and communications	30	—	1.8	
8/9	All other services	32	—	1.9	
	Total intermediate inputs	887	327	53.0	36.9
	Salaries and wages	532	—	31.7	
	Indirect taxes less subsidies	40	—	1.2	
	Rest	218	—	14.1	
	Total gross output	1677	327	100	19.5
	of which value added	788		47	

Country: Morocco

Table 3: Input structure of industry ISIC no. 339 - Year 1964

(in US$ 1,000)

		Absolute values		Input coefficients	
		Total	of which imported		2 as % of 1
1	Mining and quarrying	230	224	13.8	97.4
23	Textile industry	40	20	2.4	50.0
25	Wood manufacturing ind.	20	10	1.2	50.0
32	Petroleum & coal prod.	10	10	0.6	100.0
33	Non-metallic mineral products	223	—	13.4	—
34	Basic metal industry	3	1	0.2	33.0
35	Metal products	20	10	1.2	50.0
36/37	Machinery	32	32	1.9	—
38	Transport equipment	32	10	1.9	30.0
39	Miscellaneous industries	20	—	1.2	—
4	Construction industry	10	—	0.6	—
5	Electricity, gas, water	122	—	7.3	—
61		40	10	2.4	25.0
62/63	Banking, insurance, etc.	10	—	0.6	—
64	Real estate	10	—	0.6	—
7	Transport and communication	30	—	1.8	—
8/9	All other services	32	—	1.9	—
	Total intermediate inputs	884	327	53.0	37.0
	Salaries and wages	529	—	31.7	
	Indirect taxes less subsidies	20	—	1.2	
	Rest	235	—	14.1	
	Total gross output	1668	327	100.0	19.7
	of which value added	784		47	

Table 4 : Projection of asbestos cement products - local demand

A L G E R I A	1964	1970	1975	1980	
Corrugated sheets					
Total roofing demand - 1000 m^2	595	1090	2040	3510	
Share of asbestos cement corrugated roofing - percentage	20	20	20	20	
Asbestos cement corrugated sheets demand - 1000 m^2	119	210	408	702	
Asbestos cement corrugated sheets demand - tons	1714	3139	5875	10119	
Flat sheets for walling					
Walling demand - 1000 m^2	1363	2504	4696	8045	
Share of asbestos cement flat sheet - percentage	5	5	5	5	
Asbestos cement flat sheets demand - 1000 m^2	68	125	234	402	
Asbestos cement flat sheets demand - tons	734	1305	2537	4344	
Total sheets demand - tons	2448	4489	8412	14453	11.7
Asbestos cement pipes demand - tons	9660	16650	29160	51400	11.0
Total asbestos cement products demand - tons	19108	21139	37572	65853	11.2

Table 4 : Projection of asbestos cement products - local demand

MOROCCO	1964	1970	1975	1980	
Corrugated sheets					
Total roofing demand - 1000 m^2	725	1440	2320	3760	
Share of asbestos cement corrugated roofing - percentage	720	20	30	30	
Asbestos cement corrugated sheets demand - 1000 m^2	145	288	696	1028	
Asbestos cement corrugated sheets demand - tons	2088	4147	10022	14803	
Flat sheets for walling					
Walling demand - 1000 m^2	1685	3289	5175	8350	
Share of asbestos cement flat sheets - percentage	5	5	5	5	
Asbestos cement flat sheets demand - 1000 m^2	84	164	288	418	
Asbestos cement flat sheets demand - tons	902	1771	3110	4514	
Total sheets demand - tons	2990	5918	13132	19317	12.4
Asbestos cement pipes demand - tons	6500	15400	27552	41100	10.4
Total asbestos cement products demand - tons	9400	21318	40682	60417	10.8

Table 4 : Projection of asbestos cement products - local demand

TUNISIA	1964	1970	1975	1980	
Corrugated sheets					
Total roofing demand - 1000 m^2 (projected)	576	920	1470	2136	
Share of asbestos cement corrugated roofing - percentage	15	15	20	20	
Asbestoc cement corrugated sheets demand - 1000 m^2	86400	138000	294000	427200	
Asbestos cement corrugated sheets demand - tons	1244	1987	4234	6151	
Flat sheets for walling					
Walling demand - 1000 m^2	1377	2077	3214	4690	
Share of asbestos cement flat sheets - percentage	5	5	5	5	
Asbestos cement flat sheets demand - 1000 m^2	68850	100350	160720	234500	
Asbestos cement flat sheets demand - tons	689	1084	1736	2533	
Total sheets demand - tons	1933	3071	5970	8684	9.8
Asbestos cement pipes demand - tons	6000	11340	20170	28530	10.2
Total asbestos cement products demand - tons	7933	14411	26130	37214	10.1

Table 4: _ Projection of asbestos cement products - local demand

L I B Y A	1964	1970	1975	1980	
Corrugated sheets					
Total roofing demand - 1000 m^2	510	1850	1950	2070	
Share of asbestos cement corrugated roofing - percentage	30	20	25	30	
Asbestos cement corrugated sheets demand - 1000 m^2	114	370	488	621	
Asbestos cement corrugated sheets demand - tons	1640	5330	7000	8950	
Flat sheets for walling					
Walling demand - 1000 m^2	1356	4172	4443	4674	
Share of asbestos cement flat sheets - percentage	—	—	5	5	
Asbestos cement flat sheets demand - 1000 m^2	—	—	222	234	
Asbestos cement flat sheets demand - tons	—	—	2442	2571	
Total sheets demand - tons	1640	5330	9442	11521	13.0
Asbestos cement pipes demand - tons	3580	9750	14340	22100	12.0
Total asbestos cement products demand - tons	5220	15080	23782	33621	12.3

Table 4 : Projection of asbestos cement products - local demand

SUDAN	1964	1970	1975	1980
Corrugated sheets				
Total roofing demand - 1000 m^2 (projected)	520	788	1440	2420
Share of asbestos cement corrugated roofing - percentage	15	15	15	15
Asbestos cement corrugated sheets demand - 1000 m^2	78000	118200	216000	363000
Asbestos cement corrugated sheets demand - tons	1123	1702	3110	5227
Flat sheets for walling				
Walling demand - 1000 m^2	1102	1661	3170	5267
Share of asbestos cement flat sheets - percentage	—	5	5	5
Asbestos cement flat sheets demand - 1000 m^2	—	83000	158500	263350
Asbestos cement flat sheets demand - tons	—	896	1712	2844
Total sheets demand - tons	1123	2598	4822	8071
Asbestos cement pipes demand - tons	1840	12000	15500	25880
Total asbestos cement products demand - tons	8963	14598	20322	33951

Table 5: Proposed additional and new production capacities for asbestos cement production

	Algeria	Morocco	Tunisia	Libya	Maghreb	Sudan
Existing capacity 1000 tons	33	35	8	—	76	—
The projected demand in 1000 tons, 1970	25	37	15	15	83	15
The projected demand in 1000 tons, 1975	45	60	26	24	161	20
The projected demand in 1000 tons, 1980	75	85	37	33	230	34
Shortage in 1000 tons, 1970	(-8)	—	7	15	24	15
Shortage in 1000 tons, 1975	12	—	18	24	79	20
Shortage in 1000 tons, 1980	42	50	29	33	154	34
Proposed new plants or extensions, 1967-70	—	1 x 10	Add 7[a]	1 x 6	Add 7[a] 1 x 6 1 x 10	
Proposed new plants or extensions, 1970-75	Add 17[a]	Add 15[a]	Add 10[a]	Add 9[a]	Add 17+15 +10+9	— 1 x 15
Total accumulated capacity 1967-1970	1 x 30 1 x 10	1 x 35	1 x 15	1 x 5	1 x 3 1 x 5 1 x 10 1 x 15 1 x 30 1 x 35	—
Total accumulated capacity 1970-1975	1 x 30 1 x 20	1 x 35 1 x 25	1 x 25	1 x 15	1 x 15 2 x 25 1 x 20 1 x 30 1 x 35	1 x 15
Total accumulated capacity 1975-1980	1 x 30 2 x 25	1 x 35 2 x 25	1 x 25 1 x 20	1 x 20	2 x 20 5 x 25 1 x 30 1 x 35	1 x 15

a/ Add = additional capacity to existing establishments.

ANNEX II

Bibliographical references

1. Five industries for the Central African Republic Chapter III, AID/Afr-288, 1965.

2. A proposal for the establishment of asbestos cement pressure pipe and asbestos cement sheet project for Kenya, September 1966, Birla Brothers Private, Ltd.

3. Possibilités d'industrialisation des Etats africains et malgache associés, CEE, December 1966, 13.075/VIII/B/66-F.

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6. World Trade Annual, 1963, prepared by the Statistical Office of the United Nations.

7. Roofs in the warm and humid tropics, Otto Koenigsberger and Robert Lynn, UDC 69.024.1(213): 691.

8. Les matériaux de construction, la statistique de production, Ministère de l'industrie et de l'énergie, République algérienne démocratique et populaire.

ANNEXE II

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1. Five industries for the Central African Republic Chapter III, AID/Afr-288, 1965.

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