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Estimated production cost

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

RESEARCH PROGRAMME NO. 14

DEVELOPMENT OF ADHESIVES

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ECONOMIC EVALUATION OF ADHESIVES

REPORT NO. 1

ESTIMATED PRODUCTION COST FOR
MANUFACTURING DIALDEHYDE STARCH IN THAILAND

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SUMMARY

Production cost for manufacturing dialdehyde starch in Thailand is estimated by using data obtained in a similar plant operating in the United States. Preliminary calculation indicates that the economics of production should be carefully considered before further experimental research work is undertaken.

INTRODUCTION

Dialdehyde starch is a derivative applicable in such fields as leather tanning, paper coating and tobacco binding. The process for dialdehyde starch using electrolytic regeneration of periodic acid has given excellent results in the United States. The starch is cheap and readily available in Thailand, and the possibility of application of this process in Thailand were therefore examined.

DISCUSSION

The study was initiated with a calculation of costs for manufacturing dialdehyde starch in Thailand. The calculation of costs was based on data obtained for a similar plant operating in the United States. (See Tables 1 and 2).

The total estimated production cost in Thailand amounts to 7.58 baht per kg of product compared to 7.15 baht per kg in the U.S. The calculation was based on an annual production of 4,535,924 kg (10,000,000 pounds). This capacity is too high and another calculation was made for a smaller capacity, i.e. 952,544 kg per annum (see Table 3). In this case production cost is about 8.56 baht per kg.

Obtained figures indicate that the cost of product, for above mentioned high capacity, would be competitive with other similar imported products: C.I.F. cost of inedible starches is about 6 baht/kg,

and of casein glues about 12 baht/kg. The calculated production cost for dialdehyde starch would be about 8 baht/kg. With depreciation calculated for 5 years both for buildings and equipment, the cost would be raised up to about 10 baht/kg.

The lower capacity of about 1,000 tons/year is still too high for Thai local requirements. Table 4 gives figures on import of glues and adhesives. It does not include urea formaldehyde and phenol formaldehyde adhesives used in plywood and particle board industries. (The plywood industry uses about 900 tons/year of urea formaldehyde and 60 tons/year of phenol formaldehyde).

It is questionable whether further reduction of capacity would be feasible.

The work on this project will be continued following the arrival of an industrial economist who should carry out the following:

- Check Tables 1, 2, 3, and 4.
- Survey imports and cost of adhesives used for the same purpose as dialdehyde starch.
- Investigate exporting possibilities.

CONCLUSION

The capacity of plants manufacturing dialdehyde starch adhesive seems to be too high under present conditions in Thailand. Capital investments are also high and preliminary calculation of production costs indicates that the economics of production should be carefully considered before further experimental research work on this project is undertaken.

TABLE 1

ESTIMATED PRODUCTION COST OF DIALDEHYDE STARCH IN THAILAND

Description	Unit cost (baht)	Daily cost (baht)	Baht per kg of product
<u>Raw materials</u>			
Starch slurry, 11,839 kg dry starch	1.76 ¹	20,880.00	
Crude oxidine, 128 kg	109.20 ²	14,000.00	
NaOH, 363 kg	5.04 ²	1,824.00	
Na ₂ SO ₄ , 29 kg	12.06 ³	355.00	
H ₂ SO ₄ , 318 kg	4.41 ³	1,400.00	
Total cost of raw materials		<u>38,459.00</u>	2.99
<u>Utilities</u>			
Steam, 45,359 kg	0.033 ⁴	1,500.00	
Water, 3,407,000 litre ⁶	22.00/19,817.51 ⁵	3,600.00	
Electricity, 38,400 kWh		9,619.50	
Total cost for utilities		<u>14,719.50</u>	1.15
Miscellaneous factor supplies and expenses		2,500.00	0.20
<u>Labour and supervision⁴</u>			
Operator 6/shift @ baht 2.50/h		360.00	
Helpers 3/shift @ baht 1.50/h		108.00	
Foreman 1/shift @ baht 5/h		120.00	
Laboratory technician @ baht 7/h		504.00	
Superintendent @ baht 7.50/h		180.00	
Overhead (social security, pensions, vacations, etc.)		100.00	
Total labour cost		<u>1,272.00</u>	0.11
<u>Maintenance</u>			
Building and land ⁷ , 2%/yr. of baht 3,942,000		225.00	
Equipment ⁸ , 5%/yr. of baht 69,570,000		9,910.00	
Total maintenance cost		<u>10,135.00</u>	0.77
<u>Fixed charge</u>			
<u>Depreciation</u>			
Building, 5%/yr. of baht 3,942,000		564.40	
Equipment, 10%/yr. (baht 69,579,000)		19,300.00	
Insurance, 0.6%/yr. of baht 73,512,000		1,260.00	
Total fixed charge		<u>21,124.40</u>	1.63
Working capital charge, 7%/yr. on baht 5,418,280		1,083.66 ¹⁰	0.09
Replacement of diaphragms, three times/yr. @ 800,000		6,812.50	0.53
Replacement of anodes, one time/yr. @ baht 497,000		1,420.00	0.11
Total production cost			<u>7.58</u>

With building and equipment depreciation calculated for 5 years as practised in some case in Thailand, total fixed charge will be:

	<u>Daily cost</u> <u>(baht)</u>	<u>Baht per kg</u> <u>of product</u>
Building, 20%/yr. of baht 3,942,000	2,250.00	0.18
Equipment, 20%/yr. of baht 69,570,000	38,600.00	2.98
Insurance, 0.6%/yr. of baht 73,512,000 ⁹	<u>1,260.00</u>	<u>0.09</u>
Total fixed charge	<u><u>42,110.00</u></u>	<u><u>3.25</u></u>
Total production cost will be		<u><u>9.20</u></u>

References

- 1 S.R. Tapioca Flour Co., Ltd.
- 2 Pharmaceutical Trading Co., Ltd.
- 3 United Chemical Co., Ltd.
- 4 Thai Plywood Factory.
- 5 Estimated manufacturing costs of gypsum wallboard plant.
- 6 Metropolitan Electricity Authority.

	<u>Baht</u>
7 Land 5,000 m ² or 5380 wa ² @ baht 500/wa ²	2,692,000.00
Building 1,250 m ² @ baht 1,000/m ²	<u>1,250,000.00</u>
Total	<u><u>3,942,000.00</u></u>
8 Equipment	47,500,000.00
Installation of equipment	5,400,000.00
Other construction cost	6,255,000.00
Contingencies, engineering, and contracting fees	<u>10,425,000.00</u>
Total	<u><u>69,570,000.00</u></u>
9 Fixed capital investment	73,512,000.00
10 Working capital charge 77,404 x 0.2 x 0.07	1,083.66

TABLE 2

ESTIMATED PRODUCTION COST OF DIALDEHYDE STARCH IN U.S.A.

Description	Daily cost (\$)	Daily cost (baht)	Baht per kg of product
<u>Raw materials</u>			
Starch slurry, 11,839 kg dry	1,305.00	26,833.00	
Starch, @ 11.1 ¢	1,305.00	26,833.00	
Crude iodine, 128 kg @ 2.8 ¢	268.85	5,538.31	
NaOH, 363 kg @ 13.25 ¢	48.00	988.80	
Na ₂ SO ₄ , 29 kg @ 22.05 ¢	6.50	133.90	
H ₂ SO ₄ , 318 kg @ 5.52 ¢	17.50	455.00	
Total cost of raw materials	<u>116,455.85</u>	<u>33,299.01</u>	2.63
<u>Utilities</u>			
Steam, 45,359 kg @ 165.5 ¢ 453.6 kg	75.00	1,545.00	
Water, 3,407,000 litres @ 16.56 ¢ 19,817.5 litres	67.50	1,390.50	
Electricity, 38,400 kWh @ 0.7 ¢/kwh	268.80	5,537.28	
	<u>268.80</u>	<u>5,537.28</u>	
Total cost for utilities	<u>411.30</u>	<u>8,472.78</u>	0.66
<u>Miscellaneous factor supplies and expenses</u>	<u>75.00</u>	<u>1,545.00</u>	0.11
<u>Labour and supervision</u>			
Operators 6/shift @ \$ 2.50/h	360.00	7,416.00	
Helpers 3/shift @ \$ 2.00/h	144.00	2,966.40	
Foreman 1/shift @ \$ 2.75/h	66.00	1,359.60	
Laboratory technician, \$ 20.00/day	60.00	1,236.00	
Superintendent, \$ 38.40/day	38.40	791.04	
Overhead (social security, pensions, vacation, etc.)	99.30	2,045.58	
Total labour cost	<u>767.70</u>	<u>15,814.62</u>	1.23
<u>Maintenance</u>			
Building and land, 2%/yr. of \$ 250,000	14.30	294.58	
Equipment, 5%/yr. of \$ 2,400,000	342.90	7,063.74	
Total maintenance cost	<u>357.20</u>	<u>7,358.32</u>	0.57
<u>Fixed charge</u>			
Building, 5%/yr. of \$ 250,000	35.70	735.42	
Equipment, 10%/yr. of \$ 2,400	685.70	14,300.00	
Taxes and insurance, 3%/yr. of \$ 2,650,000	227.10	4,678.26	
Total fixed charges	<u>948.50</u>	<u>19,713.68</u>	1.53
Working capital charge, 5%/yr. on \$ 192,000	27.40	564.44	0.04
Replacement of diaphragms, three times/yr. @ \$ 22,500	193.00	3,975.80	0.31
Replacement of anodes, one time/yr. @ \$ 14,000	40.00	824.00	0.07
Total production cost		<u>7.15</u>	

TABLE 3

COMPARISON OF ESTIMATED PRODUCTION COSTS BETWEEN
TWO DIALDEHYDE STARCH PLANTS OF DIFFERENT CAPACITIES

	Production cost in baht per kg of product	
	4,535,924 kg/year plant	952,544 kg/year plant
Raw materials	2.99	2.99
Utilities	0.99	1.12
Misc. factor supplies and expenses	0.20	0.24
Maintenance	0.77	0.97
Fixed charges	1.63	2.05
Labour and supervision	0.11	0.24
Working capital charge	0.09	0.13
Replacement of diaphragms and anodes	0.64	0.64
Total production cost	7.42	8.38

TABLE 4

IMPORT OF GLUES AND ADHESIVES

Commodity	1963		1964		1965	
	Quantity in kg	C.I.F. value (baht)	Quantity in kg	C.I.F. value (baht)	Jan. - Nov.	
					Quantity in kg	C.I.F. value (baht)
Adhesive, cellophane tapes	37,380	1,554,350	95,740	3,224,085	184,516	4,392,430
Starches, inedible	7,344	77,709	3,830	24,464	10,419	61,591
Casein and other casein derivatives	37,397	338,819	38,586	346,276	24,366	336,443
Casein glues	8,169	19,692	6,087	73,315	10,869	117,652
Glues derived from bones hides, nerves tendons or similar products, and fish glues	47,293	655,584	41,814	482,098	50,098	414,455
Prepared glues and products suitable for use as glues n.e.s.	247,776	4,431,064	253,892	4,109,203	15,000	102,070
Total	385,359	7,077,218	439,949	8,259,441	295,288	5,364,641