

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND
Technological Research Institute
THA-0810SWG(SF/ID)

FINAL REPORT

on

THE RUBBER GOODS INDUSTRY IN THAILAND

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by

ROBERT GACZYNSKI

Rubber Goods Industry Consultant

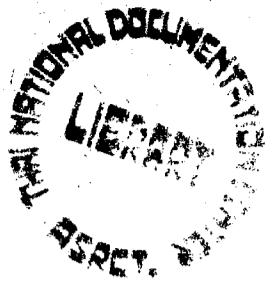
Bangkok

7 August 1972 - 6 February 1973

The writer of this report is solely responsible for the views expressed in it. Copies of the report have been submitted to the United Nation Industrial Development Organization which may in due course communicate its own assessments of the recommendations made to the Government.

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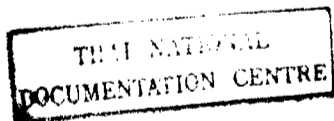
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I Summary

The detailed survey of the rubber goods industry in Thailand was carried out by visits to 35 factories and study of the statistics data on the consumption of rubber, rubber products and other items, export and import level and other figures connected with rubber goods manufacture.

About one third of the six months assignment of the expert has been devoted to activities not included in the duties given in the job description. These secondary activities concerned: (1) training and instructing the technicians and experimental work of compounding, curing and testing of rubber and fillers at the Department of Science, (2) advising the factories' staff on the raw-materials properties and processing, and (3) observing the Assembly of International Rubber Study Group as UNIDO delegate.

The results of survey show that the rubber goods industry in Thailand grew fast, especially in last four years (from 25,000 tons in 1967 to 47,000 ton in 1971 of produced rubber goods) effecting a considerable decrease of imported rubber articles (19,600 tons in 1968 and only 8,300 tons in 1971). This was due to the right policy of the Government of Thailand in promoting with economic privileges the investments in the industry and protecting the manufacture in the country with high duties on imported products.

However the export of rubber goods from Thailand is still negligible and amounts to only 2% of the production.

This is connected with insufficient quality of some rubber goods, especially rubber technical products and with lack of foreign trade organization. The consumption of rubber goods grew more slowly (only doubled in the last ten years to 59,500 tons in 1971) than the whole industrial sector of Thailand.

The consumption of rubber amounts probably of 14,400 tons of natural and 4,000 tons of synthetic rubbers in 1972, of which more than 60% is consumed in tyres and tubes. The tyres and tubes producers use most of the synthetic rubber (approx. 3000 tons) and the suggestion is to replace 2,000 tons of this rubber with natural, sparing 6 million bahts on price difference and 20 million bahts on improvement of balance in foreign trade. The consumption of 40,000 tons of natural rubber in 1976 and 83,000 tons in 1981 is projected, while the synthetic rubber consumption should amount to only 7%. About 25% of rubber goods to be produced in 1981 (31,000 tons) should be exported. It is considered to be not possible to increase the production of rubber goods more than four times in ten years period, because of investment limitation, quality problems, and lack of trade organization.

Nearly all other ingredients used in production of rubber goods are now imported, therefore the local production of zinc oxide, textile cord, carbon black and some white fillers in the near future should be of great interest for the country.

In order to assist the rubber goods industry in raising the level of technology, to promote the use of more natural rubber, and to advise the government on the policy of licence, investment and trade, it is suggested to establish a research and development centre. This can be settled on the base of experience and equipment at the Department of Science of the Ministry of Industry. At the same time the Technological Research Institute can include in its programme research and testing concerning the application of natural rubber in textile, paper and paint industry.

A additional suggestion is to produce the formic acid for natural rubber coagulation.

II Abbreviation of the Job Description

According to the text of Job Description the duties of the rubber goods industry expert in Thailand for the period of six months were as follows:

1. The detailed survey of the rubber goods industry, covering the structure, capacity, level of technology and efficiency, capital, taxes, etc.
2. Recommendations on the scope of expansion, substitution of synthetic rubbers and chemicals, import substitution, training, testing and research possibilities.
3. Advise for the establishment of a government organization to solve the problems mentioned in item 2.

III Survey of the rubber goods industry

1. Results of factory visiting.

35 factories have been visited:

- 9 rubber footwear factories,
- 12 rubber technical products factories,
- 6 tyres and tubes factories,
- 1 latex products factory,
- 1 factory producing machinery for rubber goods industry,
- 1 reclaim rubber factory,
- 4 rubber and latex manufactures,
- 1 passenger cars factory,

and 1 chemicals selling company (Bayer-Thailand),
and 1 Rubber Research Centre

The names and addresses of visited factories and other organizations are given in table 1.

The most visits were arranged by the Technological Research Institute of the Applied Scientific Research Corporation of Thailand (TRI of ASRCT) and some by the Department of Science of the Ministry of Industry. All visits were accompanied by Mr. Taweesak Rohitsukh from TRI and Mr. Verapong Chareonsri or Mr. Nibhon Patanangkura, and some visits by Dr. Charoen Vashrangsi, Chief of Physics and Engineering Division (the last three men from the Department of Science).

The more important informations from factory visiting and discussion with managing directors and other staff are gathered in seven tables. Others, concerning some details of processing, raw-materials, etc., are collected at TRI and Department of Science.

It is to mention that all data and information of factories' production, rubber consumption, number of employees, shifts working and others showed in the tables are recorded from the interviews with factories' staff. Therefore the expert is not responsible for the exactness of the figures. There are not in Thailand official statistical figures on the rubber good manufacturing industry.

a. Kind of production

The factories have been divided into three main groups of production: footwear, technical rubber products, and tyres - 27 factories altogether. The factory producing rubber goods of latex (No. 27) is shown separately as well as the reclaim rubber factory (No. 28) and the factory producing machinery for rubber goods industry (No.29). These two last have not been added to production and capacity total in Table 1.

It can be seen from table 1 that in Thailand there are produced all kinds of rubber goods generally. In the first group of production (footwear) the visited factories produce rubber slippers with cellular soles, textile upper and rubber soles canvas shoes, as well as tennis and basketball shoes, PVC upper and rubber soles school shoes. In one factory (No. 3) they produce textile upper and polyvinyl chloride (PVC) soles, canvas shoes by modern Japanese rotary injection moulding machine. The textile - rubber shoes are produced by both methods of vulcanization:

Table 1. List of visited factories

No.	Name of factory	Address		Interlocuter's name	Promotion of the Board of Invest at
		factory	office		
		<u>Rubber footwear</u>			
1	The Nanyang Rubber Ind. Co., Ltd.	P.O. Box 212 Bangkok Tel. 671115	-	Dhavajjai Sosothikul Executive Director	11.2.1963
2	Bata Shoe Co. of Thailand Ltd.	Sukuwit Road Bangkok Tel. 911776	-	V.M. Dvorak Managing Director	25.8.1959
3	Thaigem Rubber Co., Ltd. 133 Ladprow Rd.	133 Ladprow Rd. Bangkok Tel. 71932	-	Tiloy Tan Owner	
4	Thai Toho Rubber Production Co., Ltd.	608 Soi Sin Hloe Ratchburana Rd. Bangprakok Tel. 681599	-	Prakit Chari-meths Manager	
5	Jak Hoa Factory	77/15 Soi Chub-Sumboon Dowkhanons Themtors Rd.	-	Hoa	
6	Vathanakit Rubber Factory	102 Petchkasem Rd. Dhonburi Tel. 670296	-	Somchai Punyanu-traks Ass. Manager	
7	Full Hand Trading Co., Ltd.	16 Petchkasem Rd. Dhonburi Tel. 670435	-	Lim Hoo Shing Managing Director	
8	Sumit Industries Co., Ltd.	629/3 Sathupradit Bangkok Tel. 840201	-	Sumit Tiraprasert	
		<u>Rubber technical products</u>			
9	The Siamese Rubber Industry Co., Ltd.	86 Suksawad Rd. Bangjak Tel. 686115	-	Charnsak Wong-paittoonpija	28.10.1969
10	King Rubber	9 Sutissan Road Intamara 15 Span Kuaw Bangkok Tel. 13689	-	Suthep Vachira-chongkol Manager	
11	Thai Yang Rubber Factory	179 Suksawad Rd. Dhonburi Tel. 686401	119-121 Chalerm-kat 1 Suanmali Bangkok Tel. 822487	Anant Charumethee Manager	28.10.1969

Table 1 Cont.

No.	Name of factory	Address		Interlocuter's name	Promotion of the Board of Invest at
		factory	office		
12	Thai Henglee Factory	509 Soi Mitudom Samrong, Bangkok Tel. 930107	196/62 Chan Road Sapan 4 Sathupradit Bangkok Tel. 860729	Ma Peng Yan	
13	Seng Thai Rubber Factory Co., Ltd.	39/1 Petchkasem Rd. Dhonburi Tel. 670163	-	Phong Phalarit Manager	
14	Saeng Thai Rubber Factory Co., Ltd.	Soi 3 Poochaosmingprai Rd. Samrong Samutprakarn	227/4 Rong Muang Soi 3 Bangkok Tel. 54882	Kriang Ou Udom-ying Managing Director	17.2.1966
15	Sangoen Rubber Industry Ltd. Part.	134 Samrong area 19 Poochaosmingprai Rd. Prapradang Tel. 683233	-	Anek Iamsupanimit Managing Director	
16	Liang Hah Heng Factory	222 Soi 2 Chan Rd. Tel. 860672	-	Liang Hah Manager	
17	Thai Elastics Co., Ltd.	11/1 Tivanont Rd. KM. 17 Pakred Nontburi	528 Ania Keng Lane Rajawongse Rd. Bangkok Tel. 20300	Tavorn Tangsa-Hamaitri Manager	15.1.1968
18	Nam Sang Sawat Part. Ltd.	533 On the Highway to Natawee Songkla Province	-	Vichitra Apivata-karoon Manager	
19	Pattani Industry	118/1-9 Preeds Rd. Pattani Tel. 99062	-	Boonchai Nithin-thai Manager	
20	Praneet Industries	1030/2 Rama IV Rd. Bangkok Tel. 861006	-	Mano Rakvidhya-sastra	
<u>Tyres and tubes</u>					
21	Thai Sin Rubber Ind. Ltd.	65 Mou 3, Omnoy, Kratumban, Samutsakorn Tel. 69521	25/3-4 Mitrapan Rd. Makan Lane, Bangkok Tel. 223760	Charun Tosaporn Vichai	15.7.1965
22	Firestone Tyre and Rubber Co. (Thailand) Ltd.	Mou 4 Poochaosaming-prai Rd. Samuthprakarn Tel. 940311	183 Sukhunvit Klongton Prakanong Bangkok Tel. 54301-5	Nivat Wathana-chinda Chief Chemist	1.2.1964

Table 1 Cont.

No.	Name of factory	Address		Interlocuter's name	Promotion of the Board of Invest at
		factory	office		
23	Thai Bridgestone Co., Ltd.	KM 33. Phaholyo- -thin Rd. Tambol Klong Nung Tel. 796837	Sarasin Bldg. 14 Surasak Rd Bangkok Tel. 33655	T. Ikenaga Chief of Tyre Technician	5.1.1969
24	Goodyear (Thailand) Ltd.	Phaholyothin Rd., KM 36 Rangsit Post Off. Pratumtani Tel. 53041	518/4 Ploenchid Rd. Sirinee Bld. Bangkok Tel. 53041	Y. Zemla Production Direc- -tor	1.4.1970
25	Nanyang MFG. Co. (Thailand) Ltd.	41 Sooksawad Rd. Phrapradang Bangkok Tel. 685043	-	N.T. Pao Manager	17.19.1962
26	The Bentire Co. Ltd.	Phaholyothin Rungsit Bangkok	57/121 Superhigh- way, Dindaeng Bangkok Tel. 522440	Paiboon Montien Managing Director	-
27	Royal Industries (Thailand) Ltd.	126 Moo 6, Amnuy Amphur Kathumban Saruthsakorn Tel. 69306	<u>Latex products</u> 218/5-6 Soi 1 Siam Square Bangkok Tel. 516333	Rattam Sri Narula Director	-
28	Union Commercial Development Co. Ltd.	Poochaosaningprai Rd. Samrong Samuthprakarn	<u>Reclaim rubber</u> 221/4 Rong Muang Soi 3, Bangkok Tel. 53482	Kriang On Udom- -ying Managing director	1973
29	Sahawathane Machinery Part.	224 Soi 2 Chan Road Tel. 863792	-	Su Charti	-
30	Pattani Industry	118/1-4 Preeds Rd. Pattani Tel. 49062	<u>Production of natural rubber and latex</u> -	Boonchai Nithin- -thai Manager	<u>Production</u> 600 ton/year of concentrated latex
31	Tek Bee Hong Co. Ltd.	Hat - yai	-		4000 ton/year of Scrape crepe 12000 ton/year of smoked sheets 5000 ton/year of block (TTR) rubber

Table 1 Cont.

No.	Name of factory	Address		Interlocuter's name	Production
		factory	office		
32	The Nusantara Co. Ltd.	61 Siroros Rd. Yala Southern Thailand Tel. 32983	392/8-9 Siam Square Rama 1 Rd. Bangkok Tel. 512513	Lam Sui Fat Manager	5000 ton/year of Scrape crepe 5000 ton/year of block (TTR) rubber
33	Klong Ngoe Rubber Ltd. Part.	Klong-NGoe, Sadao, Songkhla Hat-yai Tel. 12	-	Keng Chow Manager	800 ton/year of concentrated latex
<u>Other Institutions</u>					
34	Bayer Thai Co. Ltd.	-	130/1 North Sa- -thorn Rd. Bangkok Tel. 34843	E.P. Stahlhut Manager of the Rubber Chemical Trade Office	-
35	Rubber Research Centre	Hat-yai	-	J.W. Blencowe Project Manager of FAO natural rubber research	-
36	Siam Motor Co. Ltd. Car Assem- -bling Factory	845 Rama 1 Rd. Bangkok Tel. 59830	-	Kavee Vasuvat Manager	1200 cars per year
<u>Additional visit</u>					
8a	Maung Thong Rubber Factory	112 Aggachai Rd. Bangkoontien Thonburi Tel. 61646	-	Pong Chinapan Manager	-

in shoe presses or in autoclave. The soles of leather-rubber shoes are vulcanized onto the leather upper by means of sole presses. Slipper soles are cut out from the vulcanized porous plates and the upper strips are moulded in press or in injection moulding machine. The boots are built by manual assembly.

The production of technical rubber goods is highly varied, as in others countries. The biggest part of production in this group are V-belts, flat power transmission belts, conveyor belts, and rolls of metal with rubber surface used mostly in paper and printing industry. The variety of rubber gaskets, seals, shock and vibration absorbers is rather small. The variety of production of rubber hoses for liquid transport is also not sufficient. There are produced some vacuum and low-pressure hoses, but there is lack of production of middle and high pressure hoses for car brakes and hydraulic operated construction equipment, hoses resistant to strong organic solvents, to acids, alkali and other chemicals, heat resistant hoses, hoses for liquid food transport, and others. The production of rubber gaskets and seals is also limited to less important assortment.

Tyres and tubes are produced in eight factories. Three of these are foreign capital companies (Firestone and Goodyear are American and Bridgestone Japanese enterprises). These three and Universal Tyres factories produce almost all kind of motor car, truck, lorry, tractor and aircraft tyres and tubes. The other factories (Nos. 21, 25 and 20) produce bicycle and motorcycle tyres and tubes, and No. 20 also some passenger car tyres. The retreading of tyres at No. 26 and other non visited factories is quite big (35 per cent of new tyres production for passenger and heavy cars). There is no production of special tyres such as giant tyres, tyres as liquid containers, non-pneumatic (solid) tyres and other special purpose tyres. The motor vehicle tyres are mostly of bias construction, but about 10 per cent of production are radial tyres. Some tubeless tyres are also manufactured.

Rubber goods of latex are manufactured at two factories (No. 27 and 19). This last one produces also packing rings and moulded goods of solid rubber and therefore has been classified to the second group of production. Factory No. 27 produces latex goods by dipping process, partly (dummies, dolls) by use thermosensitive agents.

Reclaim rubber factory (No. 28) will start with production at the beginning of 1973 using cast off tyres and other worn out rubber goods as the raw-material. Reclaim rubber will be used as a rubber compound's substitute in low amount for some rubber goods. As a non-rubber consuming factory the capacity of No. 28 can not

be included with the rubber goods plants.

Machinery producing factory (No. 29) can manufacture and assemble the parts for open roller mills, two and three rolls calander, plate presses of steam and electric heating, vulcanization autoclaves, extruders, shoe vulcanizing presses and auxiliary equipment for rubber and plastic processing industry.

b. Production magnitude and capacity

The production and capacity of tyres, tubes, V-belts and latex goods are given in Table 2 in million units (Mu), and those of footwear in million pairs (Mp). Production and capacity of other rubber goods are given in metric tons. If the production and capacity are mentioned in both, units or pairs and tons, the tons always include the articles given as pairs or units (table 2, factories Nos. 3, (, 26).

The total consumption of natural (NR) and synthetic (SR) rubbers in visited factories for production of approx. 11 million pair of footwear, 2.5 millions units of tyres and 7,000 tons of other rubber goods is the biggest in tyres and tubes production (10460 tons of NR and SR) amounting to 70% of all rubber consumption in visited factories. It can be presumed that the consumption of rubber in three small tyre producing factories (known to be promoted by the Board of Investment) should be about 1,000 ton, and in other goods factories 2,000 tons of rubber. If so the whole consumption of rubber in Thailand will be about 18,000 tons in 1972, of which the tyre sector accounts for 62 %

The capacity of tyre producing factories is almost the same as present production. It means that the increase of tyre production could be possible only by new investment. However the capacity for footwear, technical rubber goods and latex products is about 50 % higher than current production. The capacity has been estimated from the number of working shifts and the amount of existing equipment in factories.

The number of employees in the entire rubber goods' industry is probably about 6,000 people, of which at least 5,000 are working in the Bangkok area. Not more than 5 % of manufactured rubber goods are exported.

c. Substantial equipment

The specification and amount of most important equipment of visited factories are shown in Table 3. It was impossible to give the dimensions and capacity of each machine, therefore the figures of amount do not correspond to the amount of production. They show only an idea of magnitude of the rubber goods industry. It should also be mentioned that at least a half of the equipment used in the technical rubber products is not modern and is of low efficiency. Relatively there is more modern equipment in footwear and especially in tyre industry, though factory No. 21 has very old machines for tyre assembling and curing.

The quality of equipment in technical rubber products factories should be improved in the very near future, if this industry would produce more kinds of rubber parts for car assembling factories and machinery industry.

d. Natural versus synthetic rubbers

About 3,500 tons or 19 % of whole rubber consumption in visited factories is synthetic rubber (Table 2), and of this more than 3,000 tons of synthetic is used in tyres and tubes. Table 4 shows the kinds of rubber used in all mentioned groups of rubber goods manufacture. It can be seen that butadiene-styrene and butadiene rubbers are used mostly for tyre production and butyl rubber for tyre tubes and medical stoppers. It is obvious that the tubes and stoppers produced of butyl rubber are of best quality, due to the low gas permeability (tubes) and excellent chemical resistance (stoppers) of this elastomer. But there is no reason to use the butadiene-styrene rubber for tyres and V-belts production in Thailand. It may be that the formulas of compounds for tyres came from abroad, where the NR is more expensive than in Thailand. But the properties of tyres of NR only, are at least the same as those produced of blends of NR and synthetic R.

There is some technical information that cis-1, 4-butadiene rubber used with NR in proportion 3:7 in tread compound increases the abrasion resistance. It is also true that this synthetic rubber increases the slippage of the tyre on wet road. Probably the tyre producing factories use less than 30% of butadiene rubber and in such case both effects of this rubber are negligible. It is only the problem of application of new formulas without both butadiene and butadiene-styrene rubbers after some laboratory and road testing of tyres.

Table 2 - Production in visited factories

	Factory No.																				21	22
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Y	U
Kind of production	F	F	F G H R C	F	Fs	F	F	F	F V B N	G S O	G S O M B V	P S E R	N B V E R	T R X H N B	X	A	L	A E	Z A G	I, Y W G K R N F	Y	U
Production maqitute (tons, units,pairs) per year	3Mp.	5Mp.	200t 0.006 Mp.	0.1 Mp.	1.5 Mp.	0.2 Mp.	1Mp.	0.1 Mp.	1Mu (v) 0.2 Mp. (Fs) 3000t	50t.	150t	40t.	600t	300t	-	200t	1000t	300t	600t	150t	1 Mu ticycle + 0.03 M Motorcycle	0.35 Mu
Rubber consump ⁿ (tons per year)(5 Rubbers)	1000 (120)	500 (50)	125 (7)	15	100 (10)	40	100 (20)	20	1000	15	60 (3)	15	250 (3)	120 (20)	-	200	100	250	500	60	700 (15)	3000 (800)
Shifts working	1	2	1	1	1	1	1	1	2	1	1	1	2	1	-	2	2	1½	1	1	2	2
Production capacity (tons, units,pairs) per year	6Mp.	5Mp.	500t 0.2 Mp.	0.3 Mp.	3Mp.	0.5 Mp.	2Mp.	0.3 Mp.	4000 t.	100t	300t	80t	800t	500t	600t	200t	1000 t.	400t	1000 t.	1000 t.	1M + 0.03M	0.5 Mu
Number of employees	550	900	160	50	40	100	180	35	150	15	100	20	120	50	-	30	450	40	40	130	250	600
Export (% of production)	-	5	5(H)	-	-	-	-	-	30	5	50	-	10	5	-	70	5	10	10	-	-	5

A - packing rings, B - flat belts, C. adhesive cements, D - rubber dolls, E - rice harvest rubber parts,
 F - footwear all kind (Fs - slippers only), G - gaskets, H - hoses, I - stoppers, J - prophylactics, K - dummies
 L - elastic braids of rubber and textile, M - metal-R-rings, N - conveyor belts, O - Orings, P - plates,
 R - rubberized rolls, S - shock and vibration absorbers, T - tank linings, U - tyre tubes, V - Vbelts
 W - water bags, X - extrudered articles, Y - tyres (Yr - retreaded tyres), Z - foam goods of latex,
 ∅ - reclaim rubber.

Fact

21	22	23	24	25	26	27	28	29	30 Total
Y U	Y U	Y U	Y Yr	Y U	Yr	K D J	∅	Machinery	
1 Mu bicycle + 0.03 M Motorcycle	0.35 Mu	0.35 Mu	0.3 Mu	0.5 Mu bicycle Y + 0.02 M motorcycle Y	400 t. 0.06 Mu	6 Mu Y + 0.5 Mu D + 0.5 Mu K	--	-	11 millions pairs of footwear 1 mil. car tyres 1.5 mil. bicycle and 0.5 mil. motorbicycles tyres 1000 tons other rubber goods
700 (15)	3000 (800)	3000 (1200)	3200 (800)	300 (120)	260	140	-	-	12000 N Rubber 3200 S Rubbers
2	2	3	3	2	2		-	2	
1M + 0.03M	0.5 Mu	0.35 Mu	0.3 Mu	0.7 M + 0.03 Mu	500 t. 0.1 Mu	30 Mu J + 4 Mu D 2 Mu K			17 unit pairs of footwear 1.5 mil. car tyres 2 mil. motorbicycle tyres 11000 tons other rubber goods
250	600	480	400	200	120	50	-	60	5260
-	5	5	5	5	-	-	-	-	5

Factory No 8a produces 0.5 Mp of tennis and canvas shoes per year
consuming 120t. rubber. 1½ working shifts with 160 employees

Since the NR is about 3 bahts per kilo cheaper than SR and the consumption of butadiene-styrene and butadiene rubbers is approx. 2,000 tons a year, more than 6 million bahts could be saved, on price differences, 20 million bahts on improvement of balance in foreign trade, and 2,000 tons more of domestic NR can be used.

Application of high styrene resins and ethylene-vinylacetate copolymer in natural rubber compounds for porous soles of footwear increases the quality of this product and is hard to substitute by NR.

Several rubber gaskets and other oil-, liquid fuel- and heat-resistant articles must be produced of special synthetic rubbers (chloroprene, butadiene-acrylonitrile copolymer). Ethylene-propylene copolymer should be used for production of extruded seals for cars, building windows, etc. It should be considered if this very expensive in Thailand elastomer (see table 7) could be partly replaced by NR for the production (table 4, factory No.15) of some extruded products, (future application of 300 tons of NR).

e. Other materials

Apart from natural rubber almost all ingredients of rubber compounds and construction materials of rubber products (textile cord, textile fabric, wires, adhesives) are of foreign origin. But general solvent (benzine), one filler (calcium carbonate), processing oil and cotton fabric are of domestic production.

The first place in value of 140 million bahts and the second place in amount of probably 3,500 tons in import of rubber industry raw-materials is occupied by textile cord, while the synthetic rubber amounts 40 million bahts and over 4,000 tons. The import of carbon black should be more than 6,000 ton and 30 million bahts of value.

Vulcanization accelerators, sulphur, zinc oxide and aging inhibitors are another important group of imported organic ingredients of value about 13 million bahts.

The problem of manufacture of cord, carbon black, some white fillers and organic ingredients in Thailand should be considered to reduce the import costs.

Table 3. Substantial equipment (amount of units)

Kind of machinery	Factory No.																												Total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		29
Open rubber mills	14	6	5	1	4	5	6	2	3	1	4	3	5	2	3	2	3	3	2	8	4	6	2	2	2	10	3	-	-	109
Internal mixer	-	1	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	1	2	2	1	1	-	-	1	-	11	
Calander	1	1	1	-	-	-	-	1	1	-	1	-	1	-	-	-	1	-	-	2	1	1	1	2	1	-	-	-	16	
Extruder	1	1	3	-	-	-	-	-	2	-	2	1	-	2	1	7	-	4	2	2	2	2	2	2	4	1	-	-	41	
Cement mixer	2	3	2	1	-	1	1	1	1	-	1	-	2	1	-	-	-	-	1	1	1	1	-	-	-	1	-	-	21	
Spreading Machine	1	1	1	-	-	-	-	1	1	-	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	8	
Bias cutter	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	2	2	1	1	1	1	-	-	10	
Tyre builders	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	30	20	15	20	-	-	-	105	
Tyre vulcanizer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	50	30	40	30	20	-	-	210	
Shoe Vulcanizer	20	50	15	21	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	192	
Curing press	18	10	6+1 in jec tion	5	1 in jec tion	1 in jec tion	10	3	5	10	6	5	10	11	-	-	-	2	1	40	-	-	-	-	-	-	-	-	142 +3 in jec tion	
Curing autoclave	2	2	3	-	-	2	2	1	1	-	1	1	2	-	-	1	1	2	3	1	2	-	-	-	3	-	-	-	30	

Figures for factory No 8a : 4; -; 1; -; 1; 1; -; -; 24; 4; 2 respectively

Table 4. Rubbers used for rubber goods manufacturing

Kind of rubber	Factory No.																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Natural R	F	F	F R H	F	Fs	F	F	Fs V B, N	G S S O	G V S, B O M	P S S E A	N B V E R	T R X H N B	X	A	L	A E	Z A G	I, Y W, N G, F K R	Y U	Y U	Y U	Y U	Y Yr U	Y U	Yr	K D J	Worn out goods	-
Butadiene Styrene R (F) and resin (Fr)	Fr	Fr	-	-	-	Fr	-	-	V	-	-	-	-	-	-	-	-	-	-	-	-	Y	Y	Y Yr	Y U	-	-	-	-
Butadiene R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	Y	-	Y	-	-	-	-
Butyl R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I U	U	U	U	U	U	-	-	-	-
Chloroprene R	-	-	G C H	-	-	-	-	-	-	-	-	-	T	-	-	-	-	Z	-	-	-	-	-	-	-	-	-	-	-
Nitrile R	-	-	G	-	-	-	-	-	G M	-	-	R	-	-	-	-	-	-	-	G R	-	-	-	-	-	-	-	-	-
Ethylene vinylacetate (or propylene) copolymer	-	I	-	-	Fs	-	-	-	-	-	-	-	-	(X)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PVC	-	F	F	F	Fs	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A - packing rings, B - flat belts, C - adhesive cements, D - rubber dolls, E - rice harvest rubber parts, F - footwear all kind (Fs - slippers only), G - gaskets, H - hoses, I - stoppers, J - prophylactics, K - dummies, L - elastic braids of rubber and textile, M - metal-R-rings, N - conveyorbelts, O - Orings, P - plates, R - rubberized rolls, S - shock and vibration absorbers, T - tank linings, U - tyre tubes, V - V belts, W - water bags, X - extruded articles, Y - tyres (Yr - retreaded tyres), Z - foan goods of latex, Ø - reclaim rubber.

Factory No 8a uses natural rubber only

f. Quality and control testing

The testing possibilities (Table 5) and the number of experienced technicians working in factories (Table 6) can give an idea about the control of processing, and quality control of the rubber goods. Only three foreign capital factories producing tyres (Fireston, Goodyear, Bridgestone) and one footwear factory (Bata) employ a suitable number of experienced staff. While these four factories employ 29, all remaining factories have only 13, and most of them have no technicians. It is also to remark that these four developed factories can profit from the research laboratories abroad.

In the first group (footwear) seven factories have practically no testing equipment, and eight, apart from Bata factory (No. 2), need also instruction for compounding, processing and the properties of raw-materials. But the technology of rubber footwear production is relatively simple compared with tyre and technical rubber products.

It can be seen from Tables 2 and 4 that the production variety of this group is the largest and requirements for these products are very high (dynamic tests of V-belts, fuel and heat resistance of gaskets, high pressure resistance of hoses and so on).

But the situation in technical rubber products manufacture is just the worst. Only one factory (No. 20) has good equipment for testing and even for research activity. This factory possesses more than 20 different machines for testing chemicals, rubber compounds, and rubber goods and the factory's owners have experience in rubber technology. The other 11 factories of the second group have little or no experience in rubber goods technology and practically no equipment for testing. Factory No. 15 in this group will start with production of extruded seals next year and the owner has been trained in this technology in Germany.

In this condition the quality of rubber products manufactured in most of the 23 factories mentioned above is at least unstable and for some rubber goods bad. Hence, to improve the quality of rubber goods and to avoid processing troubles the proposals of training are given (table 6). It is obvious that these steps are necessary to reach the requirement on good quality products and competitive to imported rubber goods.

The advice given to the factories' staff during visits is an additional expert activity and therefore will be discussed in other item of this report.

Table 5. Testing possibilities in visited factories

Kind of testing	F a c t o r y N o .																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Chemical properties	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	+	-	-
Mixing	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	-	-
Curing in press	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	-	-
Hardness	+	+	+	-	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-
Tensile strength elongation, modulus	+	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-
Flexing	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	-	-
Dynamic properties	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	+	-	-	-	-	-
Elasticity	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	-	-
Abrasion	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	-
Flasticity	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	+	-
Vulcanization picture	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-
Together	6	8	1	-	-	1	1	2	-	1	1	1	5	1	-	-	-	-	1	13	4	10	7	10	9	6	3	-	-

Possibilities in factory No. 8a : tensile strength with elongation, hardness.

Table 6. Necessity of training

Need of training on	Factory No.																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Compounding and formula design	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	-	+	-	-	-	-	+	-	-	-
Processing operations	-	-	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	+	-	+	-	-	-	-	+	-	-	-
Properties of raw-material	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	-	+	-	-	-	+	+	-	+	-
Testing of compounds	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	+	+	-	+	-
Testing of rubber goods	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	+	+	-	-	-
Number of experient technicians working in factory	-	4	-	-	1	1	1	1	-	-	-	-	2	-	2	-	-	-	-	2	1	10	7	8	2	-	2	-	2
Together	4	-	5	5	5	5	5	5	5	5	5	5	4	5	-	5	2	5	5	2	-	-	-	-	5	-	2	-	-

All kind of training for factory No. 8 a

2. Statistical Data

In this part of the report there are gathered the data on import and export of rubber products and the consumption of the synthetic and natural rubber. Some figures, especially these concerning the consumption of rubber goods in the country and the weight amount of all rubber good manufactured, are calculated by the expert. The data about the growth of rubber goods industry are compared with the figures of the other manufactured and imported products for Thailand and for the natural rubber producing countries.

a. Consumption of natural and synthetic rubber

The consumption of natural rubber (NR) in Thailand has increased five times in ten years (table 7) and should amount to more than 14,000 tons in 1972. A similar rate of consumption growth can be seen for Ceylon and Khmer (table 8). But the consumption of NR in Thailand per capita is not so advantageous, since in Malasia, Ceylon and Khmer Republic they consume more rubber per capita, although some of these countries have started from the same level in 1961. It means that the growth of rubber goods manufacture in Thailand is slower than in some other NR producing countries.

There are not in Thailand statistical data on the consumption of NR. Even in the Rubber Division they have figures only on the production and export of NR, and the difference does not correspond with consumption, because of unknown storage amount of this rubber in the country. Therefore the consumption figures of NR have been calculated from those of production of rubber goods, mainly on the basis of information gathered during factories' visits by the expert. According to this information the consumption of NR in 30 visited factories amounts to 12,000 tons (table 3). Since the Rubber Division has registered 169 rubber goods factories in 1969 and not all small rubber goods manufacturers are known in the country, it can be assumed that 20% more of NR is consumed. The total consumption of synthetic (SR) rubber should be equal to import, which amounts to more than 4000 tons in 1971. The assortment of SR has not been estimated because of lack of the import data. It is known from factories visits that SR is used mainly for tyres (butadiene-styrene rubber) and tubes (butyl rubber) manufacture.

Table 7 Consumption of natural - and synthetic rubber
(NR and SR) in Thailand

	NR ,000ton		SR c) ,000tons	Total b)	
	a)	b)		,000tons	Kg. per capita
1962	2.5	3.0	0.23	3.23	0.12
1963	3.0	4.0	0.12	4.12	0.14
1964	5.0	5.0	0.34	5.34	0.18
1965	5.0	6.0	0.62	6.62	0.21
1966	5.0	7.0	1.00	8.00	0.25
1967	5.0	8.0	1.03	9.03	0.28
1968	7.0	9.0	2.34	11.34	0.33
1969	7.0	10.0	2.22	12.22	0.35
1970	8.0	12.0	4.03	16.03	0.45
1971	9.0	13.0	4.05	17.05	0.46
1972	12.0	14.4	4.20	18.60	0.50

Sources :

- a) Rubber Division, Ministry of Agriculture
- b) Estimated by rubber goods experts
- c) Department of Customs (as import of SR)

Table 8 Natural rubber (NR) consumption in countries producing NR

	,000 ton a)										1/2 of 72	Kg per capita b)										
	1961	62	63	64	65	66	67	68	69	70		71	62	63	64	65	66	67	68	69	70	71
Thailand	2.5	2.5	3.0	5.0	5.0	5.0	5.0	7.0	7.0	8.0	9.0	6.0	0.09	0.09	0.10	0.17	0.16	0.15	0.21	0.20	0.22	0.24
Malaysia	7.5	7.6	9.1	11.8	14.8	16.1	14.5	16.2	18.7	20.4	22.3	10.8	1.05	1.18	1.51	1.85	1.71	1.85	2.08	2.19	2.30	
Indonesia	21.0	21.0	21.0	21.0	22.0	23.0	24.0	23.0	23.0	25.0	30.0	-	0.22	0.22	0.21	0.21	0.22	0.20	0.20	0.21	0.24	
India	47.5	50.9	59.2	60.1	64.7	66.7	72.5	84.2	86.7	86.5	93.1	490	0.11	0.11	0.13	0.13	0.14	0.15	0.16	0.16	0.16	0.17
Ceylon	1.0	1.3	1.7	2.3	2.1	2.5	3.0	3.7	4.1	4.2	5.6	3.3	0.10	0.12	0.16	0.21	0.22	0.25	0.31	0.34	0.34	0.43
Khmer	0.6	0.8	0.8	1.4	1.8	1.8	2.8	2.9	3.2	-	-	-	0.11	0.14	0.14	0.23	0.29	0.43	0.43	-	-	-

Sources : a) Rubber Statistical Bulletin of the IRSG

b) United Nations, Statistical Yearbook for Asia and the Far East, 1970

c) estimated by rubber goods industry expert

b. Import and export of rubber goods

The data of import, export, production and consumption of rubber products are shown in Tables 9, 10 and 11. In order to make the figures more comparable the expert has calculated the weights of tyres, tubes and shoes from units and pairs available from statistic sources. It can be seen (Table 11) that the production of rubber goods has been doubled every five years and import decreased to a half after a maximum in 1968. Also the export of rubber goods increased remarkably but has amounted to only 10% of imported and 2% of manufactured rubber goods in 1972.

The percentage of imported rubber articles to domestic products dropped distinctly in last five years due to increase of tyres production in this time.

The main rubber goods manufactured in Thailand are tyres and tubes (62% of rubber consumption in 1972) and the second place is taken by the rubber technical products. The import amount and value of tyres and tubes dropped rapidly from maximum in 1968 and in 1972 is assumed to be not more than 10% of tyres and tubes produced in the country. The amount of imported technical rubber products like transmission and conveyor belts, rubber hoses, gaskets V-belts, and others remains nearly on the same level in last five years and in 1971 exceeded the import of tyres and tubes (Table 9). The increasing tendency of export in this group of rubber goods is have conveyor belts, rubber sponges, hoses, and rubber bends, while the import of battery containers and medical articles decreased in the last year.

The smallest part of imported rubber goods in 1971 belongs to rubber footwear although it amounts of 1.3 millions pair and 10% of domestic production in that year.

It is to mention the rapid rise of rubber gloves import in 1970, 1971 and 1972 (if the figures from the Department of Customs do not included other gloves).

The data on the import of several rubber products can give an idea about the direction of future rubber goods manufacture and promotion of investment in Thailand.

c. Consumption of rubber goods

The production of rubber goods has been calculated from total consumption of rubber (synthetic and natural) and from the amount of tyre production. The consumption of rubber goods in the country was estimated from the sum of import and production by subtraction of export.

Table 9 Import of rubber goods to Thailand a)
(units and millions bahts)

	1962		1963		1964		1965		1966		1967		1968		1969		1970		1971		First quart. 1972	
	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb	units	Mb
Transmission and conveyor belts (tons)	475	2.64	509	12.73	476	14.32	539	15.92	756	20.47	893	25.77	864	25.80	1041	31.63	527	17.1	1200	18.6	95	4.9
Hygienic and medical articles (tons)	87	5.09	79	3.80	80	4.68	155	6.38	143	7.07	100	5.71	80	5.63	120	6.67	123	7.42	61	5.3	25	1.8
Battery containers (tons)	4	0.22	1	0.04	16	0.88	16	0.73	22	1.27	34	1.82	59	2.94	41	2.11	not classified					
Others technical rubber goods (tons)	1734	27.85	2311	38.25	2329	38.02	1683	33.67	2379	67.19	3473	78.70	3897	75.23	4299	87.50	3850	98.58	2839	93.0	776	26.0
Total (tons and value)	2300	45.7	2900	54.8	2900	57.9	2400	56.7	4300	96.0	4500	102.0	4800	109.6	5400	128.0	4500	123.1	4100	116.9	396	32.7
Footwear (,000 pairs)	199	17.34	751	6.17	997	9.59	411	3.64	880	4.36	1491	8.34	1410	7.83	1904	15.80	3559	36.53	1298	11.30	112	1.6
Rubber gloves (,000 pairs)	7	0.62	11	1.05	9	0.84	12	1.11	18	1.44	20	1.81	48	2.68	29	2.45	435	2.32	521	2.97	220	1.0
Total of pairs articles (tons)	101	18.00	378	7.22	490	10.43	208	4.75	444	5.80	749	10.15	715	10.51	958	18.25	1843	38.85	727	14.27	89	2.6
Tyres for passenger cars, trucks, lorries and buses (units)	305	190.4	437	242.2	299	203.7	191	136.8	322	1823	354	210.2	537	237.7	365	155.0	206	66.2	120	51.2	25.6	94.4
Tyres for motorcycles (units)	32	1.98	49	3.12	63	3.4	74	3.74	181	9.20	156	7.95	182	8.66	334	14.33	230	12.0	70	3.6	9.4	0.51
Tyres for bicycles (units)	1842	27.71	1332	20.30	1445	20.94	1244	18.86	1444	21.48	1635	21.93	974	15.76	872	12.07	1086	9.20	244	3.90	15.4	0.26
Tubes for motorcars	271	15.07	394	19.48	288	15.29	204	10.47	147	5.75	379	19.68	393	19.72	396	14.60	155	5.44	87	4.93	21.5	1.35
Tubes for bicycles b)	743	8.82	1263	5.94	1414	6.34	1171	5.17	360	1.87	659	3.60	423	2.0	103	0.60	44	0.50	15	0.33	3.6	0.03
Total tyres and tubes (tons and value)	3063	243.6	13362	291.1	10270	249.7	7292	174.0	9354	2206	12065	263.4	14131	283.8	11562	196.4	7331	92.3	3482	64.0	629	11.59

Sources : a) Department of Customs

b) Estimated by rubber goods industry expert from pair and unit amounts

Table 10 Export of rubber goods from Thailand a)

(Tons Millions bahts)

	1962		1963		1964		1965		1966		1967		1968		1969		1970		1971		First quart. 1972	
	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb	unit	Mb
Tyres (,000 units)	-	-	-	-	-	0.1	0.07	0.4	0.03	1.1	0.52	6.6	2.8	0.2	0.25	3.0	1.5	16.1	9.3	4.6	4.04	
Tubes (,000 units)	-	-	-	-	-	-	-	-	-	-	-	4.0	0.1	-	0.03	1.0	0.1	8.0	0.6	3.3	0.37	
Technical and medical articles (tons)	75	1.15	86	1.13	102	1.30	126	1.64	163	1.95	321	2.71	289	3.36	470	5.23	483	5.35	0.14	1.30		
Footwear (,000 pairs)	35	0.17	61	0.21	67	0.24	32	0.25	11	0.04	6	0.06	60	0.30	1.0	0.01	30	0.40	8.0	0.10		
Total b) (tons)	93	1.32	117	1.34	136	1.54	151	1.92	152	1.71	168	2.53	495	5.91	330	3.66	548	7.04	826	5.65	1127	5.81

Sources : a) Department of Customs

b) Amounts of total export estimated by rubber goods industry expert

Table 11 Import, export, production and consumption of rubber goods in Thailand

(Thousand tons and Million bahts)

	1963		1964		1965		1966		1967		1968		1969		1970		1971		First quart 1972	
	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb	Tt	Mb
Import a)	16.6	353.1	13.7	318.0	9.9	235.4	14.1	325.4	17.3	375.5	19.6	403.9	17.9	342.6	13.6	251.6	8.3	195.2	1.6	46.9
Production b)	13.0		16.0		18.0		23.0		25.0		31.0		33.0		44.0		47.0		12.5	
Export a)	0.11	1.3	0.14	1.5	0.15	1.9	0.15	1.7	0.17	2.5	0.49	5.9	0.33	3.7	0.55	7.0	0.83	15.6	0.11	5.8
Consumption b)	29.5		29.6		27.8		37.0		42.2		50.1		50.6		57.0		55.3		14.0	

Sources : a) Department of Customs

b) Estimated by rubber goods industry export from rubber consumption

It was possible to use only this inexact method to show the progress in consumption but the figures for 1972 given in table 11 are comparable with information gathered in factories. The figures show that the consumption of rubber goods in Thailand has been doubled in ten years, and the rate of growth was 10% in the first and 8% in the second five years of the 10 years period.

d. Consumption of tyres per car

There have been used in Thailand approx. 2.7 new tyres per one running car (table 12). This is less than in other countries where the proportion of passenger cars to heavy cars in use is similar to Thailand, e.g. in Japan (4.0 tyres per car) and in Poland (3.5 tyres per car). Probably in Thailand one tyre runs more kilometers than in other country, because here there is no road control of tyre wear-out. It can be presumed about 10% more consumption of tyres per car if they will be used under control.

The figures of imported vehicles and those in use of passenger cars, trucks, busses and motorcycles are shown in table 13, and the growth of natural rubber consumption compared with growth of cars in use and with national account of manufacturing are given in Table 14. It can be seen the parallel growth of these three last items although the consumption of rubber grew slower in last five years than in some other countries producing natural rubber.

e. Rubber goods industry and GDP

In order to compare the development of rubber goods industry with other national products manufactured in Thailand and in countries producing natural rubber, there have been gathered several data in Tables 14, 15, 16, 17 and 18. It can be seen from Table 15 that the growth of gross domestic products per capita is much faster in Thailand than in other five countries producing natural rubber, though the rate of the growth of industry (table 14) in Ceylon and that of rubber consumption in Ceylon and Khmer are higher. Since the rubber goods manufacture is a service industry for all producing goods, the growth rate of rubber goods consumption should be faster in next period all the more that the amount of cars in use in Thailand grew more than in remaining five countries. It can be seen from Table 16 that the electricity production increased in Thailand much faster than in other countries, hence this country has better energy base for industry development. This is

Table 12 Consumption of tyres per car

	1966	1967	1968	1969	1970	1971
Tyres (000 units) produced a)	252	261	308	524	926	1070
imported b) (minus import)	322	353	530	365	203	104
Cars in use c) (passengers trucks, busses) (000 units)	225	253	285	332	398	450
Tyres per car (units)	2.5	2.4	2.9	2.7	2.8	2.7

Sources : a) Factory survey and Board of Investment
b) Department of Customs
c) Police Department, Registration Division

Table 13 Motorvehicles in use and imported
(Thousand units, Million bahts)

Import a)

Vehicle	1962		1963		1964		1965		1966		1967		1968		1969		1970		1971	
	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb	Tu	Mb
Passenger cars and taxis	5	147	9	261	11	288	11	321	15	434	23	558	28	265	24	698	15	511	9	324
Trucks, lorries, buses and rollers for trucks	6	303	8	450	12	606	15	754	21	1583	30	1035	34	1341	38	1195	26	1127	25	1278
Motorcycles	18	62	38	122	41	138	58	197	76	248	110	319	102	271	100	208	79	184	59	142
Picycles	49	30	48	31	45	30	44	29	34	22	38	34	35	20	29	16	14	10	5	3

In use b) (,000 units)

	1966		1967		1968		1969		1970		1971	
	B'kok only	Total	B.KK	Total	B.KK	Total	B.KK	Total	B.KK	Total	B.KK	Total
Passenger cars and taxis	81.4	115	99.2	135	120.5	162	152.8	194	178.5	221	193.5	250
Trucks and buses + rollers for trucks	29.4	110	34.9	118	43.1	123	38.0	138	45.5	177	44.6	200
Motorcycles	46.3	168	54.6	221	66.2	254	67.5	311	77.4	349	80.9	376

Sources : a) Department of Customs
b) Police Department, Registration Division

Table 14 Growth of cars in use and natural rubber consumption
in natural rubber producing countries compared to
manufacturing growth
(units per cent of 1960)

	1960	1963	1966	1969	
national account of manufacturing a)					
Thailand	100	147.3	212.2	290.8	
Malaysia West	100	117.7	173.5	228.6	
Indonesia	100	117.7	111.5	143.2	
India	100	145.5	189.6	237.8	
Ceylon	100	169.3	209.2	345.0	
Khmer	100	137.2	173.5	-	
passenger and commercial cars (000units in brackets) a)					
Thailand	passenger	(48.3) 100	125	171	254
	commercial	(50.5) 100	131	176	234
Malaysia West	Pass.	(96.6) 100	134	182	227
	comm.	(31.6) 100	124	153	179
Indonesia	pass.	(103.0) 100	139	174	205
	comm.	(92.0) 100	110	130	127
India	pass.	(282) 100	132	162	180
	comm.	(246) 100	131	162	200
Ceylon	pass.	(83.0) 100	99	100	104
	comm.	(31.0) 100	110	119	136
Khmer	pass.	(10.7) 100	150	187	229
	comm.	(6.1) 100	144	169	179
natural rubber consumption (,000tons in brackets) b)					
Thailand	(2.5) 100	120	200	280	
Malaysia West	(7.7) 100	121	217	250	
Indonesia	(20.0) 100	105	110	110	
India	(45.5) 100	128	147	191	
Ceylon	(1.0) 100	168	249	408	
Khmer	(0.5) 100	159	355	652	

Sources: a) United Nations, Statistical Yearbook for Asia and the Far East
b) Rubber Statistical Bulletin of the IRSG.

confirmed in the next table that the growth rate of industry is the highest apart from electricity with water supply (Table 17).

The growth of import value to Thailand is almost the same as for other countries producing NR (Table 18). It means that the GDP in this country comes above all from its own production

IV Secondary activity

1. At the Department of Science

The laboratory of the Physics and Eng. Division of Department of Science is engaged inter alia with testing of several rubber goods (tyres, rubber foot-wear, belts, silencer mountings, cable insulations and others). For this testing they use some laboratory apparatus. Another equipment for rubber processing was installed but not put in motion. Dr. Charoen Vashrangsi urged the expert to engage in demonstrating other test methods and in compounding for training the technicians of the Department of Science.

During six months mission in Thailand the following work in this field was done with expert supervision:

a. Operation of testing equipment:

- put in operation the open roller-mill for mixing the rubber with ingredients (rubber compounds producing).
- put in operation the hydraulic press heated by steam for moulding and vulcanization of rubber compound samples.
- put in operation the bending and compression testing apparatus.
- put in operation the rebound resilience (elasticity) tester.

b. Testing of rubbers and fillers.

- design of formulas for standard testing and formulas to investigate the usefulness of Thai calcium carbonate and clay (Kaolin) for the rubber processing industry.
- producing 30 rubber compounds by mixing the ingredients with rubber on the mill.
- curing these compounds in moulds and press to get the samples for testing.

Table 15 Gross domestic products per capita in natural rubber producing countries a)
(1962 market prices)

	1960	61	62	63	64	65	66	67	68	69	70
Thailand bahts b) % of growth	2125 100	2180 102.6	2275 107.1	2445 114.9	2480 115.1	2605 122.6	2820 132.5	2890 136.0	3035 142.7	3240 154.2	3350 158.0
Malaysia dollars % of growth	838 100	829 99	836 100	869 103.8	898 106.1	950 113.7	971 116.0	935 117.6	1000 119.4	1046 124.8	- -
Indonesia rupiahs % of growth	3640 100	3750 103.0	3750 103.0	3580 98.4	3620 92.5	3575 98.3	3585 98.5	3550 97.5	3650 100.3	3755 103.1	- -
Khmer riels % of growth	4120 100	4020 97.6	4360 105.8	5100 124.0	4980 121.0	5140 124.9	5160 125.0	- -	- -	- -	- -
India rupees % of growth	312 100	315 101.0	324 103.9	325 104.2	333 106.7	324 103.9	307 98.4	321 102.9	327 104.5	- -	- -
Ceylon rupees % of growth	658 100	658 100	657 992	678 103.0	684 103.9	694 105.5	711 108.0	745 113.3	766 116.4	804 122.2	- -

Source : a) United Nations, Statistical Yearbook for Asia and the Far East, 1970

b) National Economic Development Board of Thailand

Table 16 Development of countries producing
natural rubber (value per cents of 1960)

	1960	1963	1966	1969
gross domestic products				
Thailand	100	123.6	159.2	200.6
Malaysia West	100	114.1	139.6	162.3
Indonesia	100	105.4	119.3	130.2
India	100	112.0	114.2	131.1
Ceylon	100	110.8	124.6	150.7
Khmer	100	134.0	143.5	-
national account of manufacturing				
Thailand	100	147.3	212.2	290.8
Malaysia West	100	117.7	173.5	228.6
Indonesia	100	111.7	111.5	143.2
India	100	145.5	189.6	237.8
Ceylon	100	169.3	209.2	345.0
Khmer	100	137.2	173.5	-
electricity production				
Thailand	100	160.0	360.0	654.0
Malaysia West	100	139.5	155.3	259.0
Indonesia	100	136.4	154.5	172.7
India	100	151.5	201.0	264.0
Ceylon	100	150.0	173.3	240.0
Khmer	100	150.0	150.0	211.2

Source : United Nations, Statistical Yearbook for Asia and the Far East,
1970

Table 17 Future growth of Gross Domestic Products (GDP)
in Thailand (10⁹ baht)

	1971		1976		Growth rate		
	value	%	value	%	Annual		Total 1971-76
					1967-71	1971-76	
Agriculture	37.3	29.5	47.8	26.8	4.1	5.1	28
Industry	21.4	16.9	31.4	17.6	9.2	8.0	47
Electricity and water supply	1.9	1.5	3.9	2.2	20.7	15.0	105
Others	65.8	52.1	95.1	53.4	-	-	44
GDP	126.4	100	178.2	100	7.2	7.0	41.2

Source : National Economic Development Board, 1971

Table 18 Total export and import **growth** in countries
producing natural rubber

(value per cents of 1960)

Import				
	1960	1963	1966	1969
	import			
Thailand	100	113.1	119.2	126.7
Malaysia West	100	118.8	123.7	133.3
Indonesia	100	95.0	91.3	136.0
India	100	106.5	115.4	138.2
Ceylon	100	76.2	103.7	129.5
Khmer	100	112.0	118.0	126.7
	<u>export</u>			
Thailand	100	113.0	166.5	173
Malaysia West	100	96.6	106.8	137.7
Indonesia	100	83.4	80.8	88.2
India	100	117.7	157.1	217.0
Ceylon	100	93.3	93.3	103.8
Khmer	100	129.3	95.8	112.6

Source : United Nations, Statistical Yearbook for Asia and
the Far East, 1970

- preparing the specimens for testing.
- testing the tensile strength, elongation, deformation after break, hardness, rebound resilience, pressure resistance, thermostat aging, outdoor aging of all vulcanized compounds (more than 500 testing measurements together). The specimens for longer term aging are still under test.

c. Training and instructing

- lecturing the counterparts at Department of Science on the properties of rubber raw-materials and formula designing.
- instructing one counterpart at Dep. of Sci. on rubber processing operations and their influence on the rubber properties.
- training one counterpart at the Dep. of Sci. on mixing, vulcanization and testing methods mentioned in item b.

The preliminary results of testing show that locally made clay (Siam Clay) used in paper industry can be applied as filler in the rubber goods manufacture, while local precipitated calcium carbonate is not as good as that from import. Further testing should be done on these two fillers to confirm the preliminary results and to check the processing properties in factory conditions before involving them into manufacture of rubber goods (table 19)

2. As a UNIDO observer at an international conference.

On the request of the UNIDO Head Office-Vienna the expert has attended the 23rd Assembly of the International Rubber Study Group as a representative of UNIDO. The meeting was held in Bangkok at 16 - 20 October 1972. A special report on this subject is attached as an appendix No. 1

3. Advice to factories' staff

During factory visits many problems of rubber processing, raw-material properties, testing of rubber and rubber goods have been discussed, especially in the factories without experienced staff. The largest number of consultations were given about raw-materials properties, application, formula design and the manner of their use. More than half of visited factories have a very slight idea about chemical properties and compounding. Some of them get the formula prescription from companies selling chemicals, but in this

Table 19 Filler Investigation in Synthetic Rubber

Filler		Tensile strength (Kg/cm ²)	Elongation of break (%)	Tear strength (Kg/cm)	Rebound Resilience (%)	Hardness (°Sh)
Kind	parts					
-	-	26.1	250	13.5	20	50
Siam Clay	70	78.8	450	34.5	11	58
Royal Clay	70	67.8	400	32.2	12	61
Light Kaolin (import)	70	84.6	375	41.2	10	61
Caco ₃ precip.	70	35.4	450	13.9	11	54

Compound: Perbunan 2818; 100; ZnO 5; Stearic acid 1;
 Sulphur 2; acceleralor DM 1.6; PBN 1;
 " D 0.6; Filler 70

Vucanization: 2 mm. plates at 150°C and 20 min.

case it is difficult to replace one ingredient for another. In the factories with good experience on the application of chemicals the consultations concerned mostly the use of domestic chemicals such as processing oil, calcium carbonate, clay.

The expert suggested also to use some very simple test methods such as compression set, elongation of strips of cured rubber, immersion in solvent for testing the swelling resistance of rubber goods, outdoor aging tests, etc. A large number of consultations concerned the daily troubles of production and technology and dealt mainly with rubber goods quality (table 20)

The total time devoted to the additional activity at Department of Science and for Rubber Conference amounts about two whole months of the expert stay in Bangkok.

V Recommendations

1. Expansion at rubber goods production

a. Growth of the industry

The growth of the national products and specially of the industry depends on the service manufactures like electricity, transport assembly parts and tools of rubber and plastics, and others. Especially the automotive and other vehicles industry, as well as machinery industries, are very closely connected with rubber products industry. If the production and delivery of rubber parts will stay behind the growth of the whole industry, then development of the country could be hampered.

In Thailand the growth of gross domestic product per capita, of manufacturing and of electricity production is faster than in some other countries producing natural rubber (Table 16, 15 and 16). But the consumption of natural rubber and more distinctly that of rubber goods is not so fast (Table 11).

Table 20 Advice given to factories (number)

Kind of advice	Factory No.																													Total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		
Raw-material properties and use	2	2	3	5	2	2	1	2	1	2	1	1	-	-	-	-	-	2	2	1	2	-	-	2	3	-	6	-	2	-	44
Compounding	-	-	2	-	2	-	-	-	-	-	1	1	1	3	-	3	-	1	3	1	1	-	-	-	-	4	-	-	-	-	23
Curing	-	-	1	2	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	9
Rubber goods construction	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	-	5
Adhesives	-	-	-	-	-	1	-	2	2	1	-	2	1	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	-	12
Testing methods	-	-	1	-	2	1	1	1	2	2	4	-	-	-	-	-	3	2	2	-	-	-	-	-	-	3	-	-	-	-	24
Other	-	-	-	-	-	-	2	1	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	2	-	-	2	-	10
Together	2	2	7	7	6	5	2	7	6	6	8	6	2	4	-	3	5	10	2	4	-	-	-	2	3	-	21	-	2	2	127

The future growth of industry in the country is estimated as 8% per annum or 47% in the period 1971-76 (table 17). In order to develop the industry satisfactorily, the consumption of rubber goods should increase by 170% or 11% per annum in the same period. In 1966 - 71 the growth of industry was 9.2% and of rubber goods consumption only 8% per annum (see Tables 11 and 17).

b. Import substitution

The import of rubber goods dropped more than $\frac{2}{3}$ in last five years (from 69% in 1967 to 18% in 1971 of the rubber goods production) - Table 11. This is due to production increase of tyres and tubes especially, but also of rubber footwear, medical articles and others. However the import even of these items in 1971 remains still quite big. Some other rubber goods like transmission and conveyor belts, rubber gloves, V-belts, plates, rubber hoses, gaskets are imported nearly in the same amount for many years.

The expert assumes that not more than 5% of consumed rubber articles should be imported in 1981. In this amount could be included special tyres, gaskets of extremely high requirements, special high pressure hoses and some medical articles. However all kinds of belts, rubber shoes, plates, V-belts and latex articles should be produced in Thailand.

c. Export expansion

In 1971 for the first time the value of exported tyres exceeded the value of exported technical rubber goods (Table 10) while the total weight of exported rubber goods was five times higher than in 1967. As tyres have been mostly produced by world known companies and the quality is good and uniform, the further export growth of this product can be presumed. The labour in Thailand is still cheap which bears the good possibility to produce more and to export such rubber goods as footwear, hoses, V-belts, rubber dolls and prophylactics, bicycle tyres and other hand made or less mechanized articles and also such natural rubber consuming products like camel back, plates, foam rubber mattresses sheets etc. The export of rubber goods can be presumed to grow at the same rate at least as in last ten years, then in 1976 it will amount to 7% and in 1981 more than 24% of consumed rubber goods in Thailand (see Table 23).

d. Projection of future production

The total presumed production of rubber goods, these for domestic consumption and for export in the period of ten years should be four times higher than at present (see table 23). It is hard to believe to produce more than 4 times because of the limitation of investment, of staff experience, and of the growth of local market and export opportunities.

Even the export of more than 24% of consumed rubber goods (about 38,000 tons in 1981) will be realistic in case of good cooperation between rubber goods producers and an export trade organization which could represent the manufacturers and will study the capacity and technical requirements of foreign markets. Such trade organization must be established in the near future.

e. Quality problems

The appearance and quality of several rubber goods manufactured in Thailand are not satisfactory and therefore these articles are not competitive with imported goods and are difficult to export. To these articles belong gaskets, some kinds of rubber footwear, rubber hoses, V-belts rubberized rolls, some medical rubber articles. For example V-belts have failed the test at one car company in Japan and the Japanese car assembly factory in Bangkok has to use imported belts.

There are two general ways to improve the quality of rubber goods: (I) licence or know-how, and (II) increase the rubber processing knowledge of technical staff in factories. The expert assumed as necessary to provide with know-how the technology of V-belts, high pressure hoses and of some rubber gaskets, while the other rubber products can be produced on the base of existing technology and experience, especially in the factories with modern equipment and testing possibilities.

The laboratories at the Department of Science of the Ministry of Industry can be of great assistance to the rubber goods industry enlarging the services to the industry by means of testing more rubber goods than at present and advising the industry on raw-material and processing problems. For this purpose the Department of Science must be provided with necessary testing and research equipment,

In this way a continuous progress in quality of rubber goods can be assured for expansion of rubber goods manufacture, to face the competition of imported products and to expand the export rate.

A number of factories visited by expert and counterparts are able at present to satisfy the quality for same rubber goods requirement also for export. To this group belong factories of Nos: 1.2, 15, 16, 17, 20, 22, 23, 24, 25, 26, 27, 28 (see Table 1).

f. Prices and taxes

The growth of rubber goods production, import substitution and export expansion depend on the level of prices of rubber products and raw-materials. In an attempt to boost Thai-made products and to reduce the prices the Government of Thailand enacted the Promotion of Industrial Investment Act in 1962. The promotion certificate inter alia confers the privileges of exemption from import duties and business taxes on all machinery and equipment, exemption from all income taxes for five years, protection for the promoted production by raising customs duties on the import of competing products or by banning their import altogether.

Further facilities for rubber goods producers comprise refund of taxes and fees on articles (mostly tyres) for export or for sale to government agencies or state enterprises under loan or aid program. The producers of tyres are also entitled to additional refund on import duty on machinery and equipment and on business tax (if not granted with investment promotion certificate), on imported raw-materials, on re-export tax and some others. The fund will be paid in form of a tax certificate to be used as credit reference for future payable tax.

These privileges enable the rubber goods manufacturers to compete with imported articles all the more that the import duties on rubber goods are quite high.

It seems to the expert that the Government of Thailand policy promoting the rubber goods industry in several ways mentioned above should be in principle efficient for expansion of production and export of rubber articles.

In order to facilitate the production of tyres the import duty imposed on synthetic rubber is only 30%.

Table 21 Duty of commodities
imported to Thailand in 1969
(per cents of C.I.F. price)

I	Raw - materials for rubber goods manufacture
30%	- synthetic rubber, reclaim rubber, carbon black, zinc oxide, stearic acid, accelerators, oxidation inhibitors
II	Rubber products
15%	- heavy tyres
30%	- other tyres, tubes, tyres flaps
50%	- hygienic, medical and surgical articles, transmission, conveyor and elevator belts, gaskets, gloves, bands, V-belts, battery containers
60%	- footwear and slippers of rubber
80%	- batteries for cars (up 1972)
III	Motorvehicles and bicycles
5%	- tractors
30%	- bicycles
40%	- motorcycles, trucks, lorries
60%	- passenger cars

Source : Department of Customs

Table 22 Prices of raw-materials for
 rubber goods production
 (October 1972)

Commodity	Price (baht/Kg.)	
	Lowest	Highest
Natural rubber	6	8
Butadiene-styrene R	9.5	9.5
Chloroprene R	15	15
Butyl R	14	14
Ethylene-propylene R	20	20
Butadiene R	9	10
EVA - elastomer	9.5	9.5
PVC	8.5	9.5
Sulphur	2.6	3.5
Accelerators	25	50
Antioxidants	25	75
Plasticizers	2.5	5
Stearic acid	8	8.5
Blow agents	23	40
Zinc oxide	8	10
Carbon black	5	8
Calcium carbonate	1	3
Magnesium carbonate	6	15
Kaolin	1	3
Silica fillers	8	13
Adhesives	60	100

But such synthetics as butadiene and butadiene-styrene rubbers replacing the natural rubber must be subject to very heavy (more than 50) import duty to persuade the tyre manufacturers to use only NR in tyre production.

Also the future production of such rubber ingredients as zinc oxide, carbon black, textile cord or reclaim rubber will be feasible if the import duties on these raw-materials will be considerable increases (Table 21 and 22).

g. Future consumption of natural rubber

Natural rubber produced in the country will be used mainly for the rubber goods manufacture but some quantities of NR can find application in the paint industry, for carpet backing and in paper and textile manufacture.

The paint industry can use natural rubber modified by chlorination as weather and chemicals resistant paints. For paper and textile treatment the NR must be modified with polar chemical groups (such rubber is known in Malaysia). For carpet backing the natural latex can be blended with locally produced chalk and kaolin, and other ingredients.

The production growth of rubber goods industry (consuming natural and synthetic rubbers) for domestic consumption and export can be forecasted as followed:

Table 23

Projection of future production of rubber goods

	1971		1976		1981	
	.000 tons	% of growth	.000 tons	% of growth	.000 tons	% of growth
For domestic consumption	46	100	87	190	152	330
For export	1	100	7	700	338	3800
Total production	47	100	94	200	190	401
Import	8	100	8	100	8	100
Total consumption	54	100	95	176	160	296

The average consumption of natural and synthetic rubbers for one weight unit of rubber product should remain on the same level of 36%, but the rate of synthetic rubber to total rubber consumption ought not to exceed 10%. The calculated projected consumption of rubbers in 1976 and 1981 should be 40,000 and 83,000 tons respectively (table 24)

Table 24 Future consumption of rubbers (.000 tons)

	1971	1976	1981
For rubber goods:			
NR	13	34	68
SR	4	4	6
For other products	-	6	15
Total NR	13	40	83
NR $\frac{\text{consumption}}{\text{production}}$	4%	10%	18%

Source: a) Rubber Division, Dep. of Agriculture

2. Substitution of synthetic rubber

It was already mentioned in this report (item III,1,d) that some special kind of synthetic rubbers must be used for production of tubes, some hoses, medical articles, gaskets and others to assure the good quality of rubber products. But the application of those kinds of synthetic rubbers (polybutadiene, polyisoprene and butadiene-styrene rubber) which substitute natural rubber in other countries non-producing NR must be avoided in Thailand. It must be emphasized that the quality of tyres produced without use of this kind of synthetic rubbers can be at least the same. Therefore the use of all NR in tyres produced in Thailand should be enforced.

This is a difficult problem, because of the dependence of large rubber goods companies in Thailand upon foreign capital from a parent company abroad. The fast expansion of synthetic rubbers capacity, and the decreasing prices of these products as well as an excellent technical service to rubber goods industry can pose a serious threat for natural rubber even in the countries producing this rubber. Therefore apart from a special tax policy

to promote the application of natural rubber in the country, the establishment of a research and development centre which will serve the rubber goods producers in application of this rubber is necessary.

3. Substitution of chemicals

The amounts and values of imported ingredients used in rubber compounds, and textile cord are high enough to produce these materials in Thailand as soon as possible in order to reduce import costs and improve foreign trade balance. In the period of 1972-76 the production of carbon black and some inorganic ingredients should be feasible. Only one white filler (precipitated calcium carbonate) is produced, although the quality is somewhat lower than imported carbonate.

a. White fillers

They use here in rubber footwear and in rubber technical articles manufacture quite a large number of white fillers for whitening (titanium dioxide, lithopone, zinc oxide), for reinforcing (silica, calcium silicate, magnesium carbonate, kaolin, surface modified calcium carbonate), and for price reducing of rubber goods (kaolin, calcium carbonate, talcum).

Calcium carbonate is produced in the country by precipitation, but its application is limited to cheap and of lower quality rubber footwear because of its higher particle size, which decreases tensile and tear strength and increases the abrasion. The consumption of this calcium carbonate can be increased if the quality will be improved, which should be possible in the existing factory.

In the South of Thailand they produce the natural clay which after washing, sedimentation, particle separation and drying is used in paper and paint industry. This clay, produced by Siam Clays Company, ought to be a serious competitive filler for imported kaolin and for calcium carbonate in some rubber goods. The presumed consumption of this filler should be about 2,000 tons in 1975. The application of this clay must be preceded by supplementary testing and technical promotion to rubber goods producers.

b. Carbon black

Carbon black is the most important reinforcing filler for rubber and is used above all in tyres and tubes but also in other black rubber goods. Usually the consumption of carbon black is at least of 30% of consumed rubber and in Thailand should amount not less than 6,000 tons.

The production of carbon black used in rubber goods industry is not simple and the efficient capacity of a plant unit is about 10,000 tons. This was probably the reason that the company which got the investment promotion for 3,000 tons per year of carbon black has not actually started with the production.

However the production of rubber goods will increase quite fast and the amount of 10,000 tons of carbon black consumption (50 million baht of value) can be reached in 1975. Therefore it is reasonable to start in 1973 with investment of carbon black plant with know-how from one of the well known producers (Columbian Carbon, Cabot, Ashland, Phillips companies).

c. Zinc oxide

This white powder is used mainly as an vulcanization activator for almost all rubber goods and as a white filler. The consumption of zinc oxide in 1972 for rubber goods manufactured in Thailand is approx. 1,000 tons and about the same for paint industry. With the promotion of the Board of Investment of the Government of Thailand, one factory will start with zinc oxide production of 2,000 tons capacity in 1973 (Thai-Lysaght Co.Ltd.) Since the company is a joint venture with Australian know-how they hope to produce zinc oxide of best quality and to cut out the import from Korea, Japan and Australia. The value of the production will be about 15 million bahts per year (see table 22)

d. Textile cord

At present the nylon textile cord in the shape of fabrics for car and truck tyres manufacture and as thread for V-belts production is imported from Japan. Only cotton and rayon fabric for conveyor and transmission belts, for bicycle tyres and rubber-textile footwear is produced in Thailand.

It will be very reasonable to produce nylon and in future also polyester cord in Thailand for domestic use and for export even if the fibres will be imported at the beginning. The investment cost for production of 5,000 tons per year should not exceed 100 million bahts, which will be recovered in a very short time (see item 11, 1,e). The factory should be provided with machinery for spinning, weaving and treatment of dipping and stretching (3T treatment). For this complicated production providing with know-how should be necessary.

b. Organic chemicals

At least 300 tons (10 million bahts of value) of vulcanization accelerators, antiaging and blowing agents and other organic chemicals have been used in rubber goods industry in Thailand. These are imported from Germany (Bayer), England (ICI, Monsanto), USA and Japan. As these chemicals are of difficult composition and the technology is quite complicated the production of them can be not advisable in the period of 1971-76.

4. Development of the technology

It is just mentioned in this report the need of training and testing to raise the level of the rubber goods technology and the quality of products (items III.1.f; IV.1.c and V.1.d).

a. Testing possibilities

At the Physics and Engineering Division of the Department of Science there is a laboratory for testing of rubber products manufactured in rubber goods factories. There is also equipment for testing the tensile strength, elongation, modulus, tear strength, compression set, adhesion, abrasion, rebound resilience and aging for the specimen prepared from rubber articles. The laboratory has been testing the properties listed above for tyres, rubber footwear, hoses, some gaskets, flat - and V-belts, and some rubber vibration absorber. The fatigue resistance of belts can be also tested on the special stand.

At least four technicians are carrying out these tests and the Division prepares special certificates for rubber articles fulfil the necessary requirements. Under supervision of the expert some equipment was put in operation (see item IV), especially that for preparing laboratory compounds of rubber with ingredients, and at present the Department can carry on a limited testing of rubber and rubber ingredients for factories. One technician has been also trained on compounding, vulcanization and testing. But still there is a need for more training and teaching the technicians at Department of Science especially on formula design of rubber compounds, on further testing methods and interpretation of testing results for evaluation of the quality of rubber and other raw-materials used in rubber goods manufacture. These tests are very important for application of new raw-material, especially locally produced and for improving the rubber compounds used in factories.

b. Technicians training

One very important condition for improving the products quality is to have experienced technical staff in factories. At present only about ten factories employ trained technicians and engineers. The necessity of training was discussed in factories during expert visits (see table 6.) The expert has taught occasionally the counterparts at the Department of Science about some problems of rubber goods technology and properties of raw-materials, but this was quite insufficient to prepare them as the lecturers and advisers for training the technicians from factories.

c. Rubber goods industry research and development centre.

The assistance of the Department of Science is limited to testing of some rubber goods and this is not sufficient for expansion of rubber products manufacture. The secondary activity of UNIDO rubber goods industry consultant done at the Department of Science and in factories can be recognized as the start of assistance on advising, training, teaching, testing and on research work in this field. In order to continue this activity it is necessary to involve more the Department of Science in these activities by organizing a special centre for research and development of the rubber goods industry.

The program of activity of such centre should include:

1. wide applied research and testing on rubber, ingredients, rubber compounds and vulcanizates
2. testing of rubber products
3. further application of natural rubber and locally made ingredients in the industry
4. basic theoretical research on the structure of crude and crosslinked rubber
5. advising the factories on technology and properties of raw-materials and rubber products
6. assisting the government on the problem of rubber goods quality, technology level, expansion possibilities, buying of know - how, investment necessity and other
7. cooperation with a rubber goods foreign trade organization, which should be established
8. cooperation with the Rubber Research Centre in Hat-yai and with the Technological Research Institute on properties and application of natural rubber in the industry
9. cooperation with rubber goods industry research institutions abroad
10. data and technical information gathering for statistical documentation about rubber goods industry.
11. publishing activity (rubber bulletin) about rubber goods technology and production.

The programme can be fulfilled gradually according to increase of staff number, experience, and number and kind of equipment.

In the first stage of activity which can be realized in present conditions at the Department of Science the following work can be done: testing the properties of fillers; limited testing of rubbers, plastisizers and curing agents; limited testing of rubber goods; and a very limited research on rubber crosslinking and degradation.

The escalation of the research and development centre activity will depend on the number and quality of staff, and kind and number of laboratory equipment. But further assistance of the United Nations for supervising, elaborating the research programme in details, factories advising, training and teaching seems to be indispensable for the centre, especially during the first 1 - 2 years.

The best and fastest way to educate the staff at the Department of Science on the knowledge of rubber processing technology is to send 1 - 2 capable of university degree educated technicians for one year fellowship study at one of the world-known research centres like the National College of Rubber Technology in London, England or the Natural Rubber Producers' Research Association in Welwyn Garden City, England and the Rubber and Plastics Research Association of Great Britain, Shewbury, Shropshire, England

d. Collaboration with the Rubber Research Centre.

In the field of research and development of natural rubber consumption some countries as Thailand, Cambodia and Indonesia do nothing at present. Only the Natural Rubber Producers' Research Association is very successful in research on application of natural rubber produced in Malaysia.

The Rubber Research Centre in Hat-yai, Thailand is not prepared to conduct the research and testing activity leading to increased consumption of natural rubber, to answer the processing problems, improving the quality of rubber products and to apply locally made ingredients. This Centre has neither the necessary equipment nor educated and trained staff for this activity.

Therefore it seems to be not reasonable to organize a research and testing centre for rubber goods industry at this centre, all the more so as this industry is concentrated in Bangkok area.

But close cooperation will be indispensable, between the Department of Science, the Applied Scientific Research Corporation of Thailand and the Rubber Research Centre on research programming, discussion of the test results of NR and on the policy of natural rubber application and export.

5. Additional recommendations

- a. In item V.1.g. of this report the possibility of future consumption of natural rubber in paint, textile (carpet backing, impregnation) and paper industries has been mentioned. The application of NR apart from the rubber goods industry must be preceded also by necessary research and testing activity. The expert suggests to involve the Technological Research Institute of the Applied Scientific Research Corporation in these problems of NR application.

- b. Recently a promotion certificate has been given to a factory in Bangkok for production of formaldehyde and some thermosetting resins. For coagulation of natural rubber there is used in Thailand an imported formic acid, or cheaper but decreasing the properties of rubber, sulphuric acid. But the expert suggests to produce the formic acid locally at the factory producing formaldehyde. The demand for formic acid should be about 1,000 tons in 1973 of 8 million bahts value.

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Appendix 1

REPORT

ON THE 23rd ASSEMBLY OF
THE INTERNATIONAL RUBBER STUDY GROUP
IN BANGKOK, 16-20 OCTOBER 1972

BY UNIDO OBSERVER

Dr. Robert Gaczynski

Rubber Goods Industry Expert

in Thailand

BANGKOK, 24 October 1972.

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REPORT

On the 23rd Assembly of the International Rubber
Study Group, held in Bangkok on 16-20 October 1972:
Prepared by Mr. Robert Gaczynski, UNIDO observer.

I. Introduction

The 23rd Assembly of IRSG was attended by 164 delegates from 27 member countries: Australia, Austria, Belgium, Brazil, Canada, Checkoslovakia, Denmark, France, Federal Republic of Germany, India, Indonesia, Italy, Japan, Khmer Republic, Liberia, Malaysia, Netherlands, Poland, Singapore, Sri Lanka, Sweden, Thailand, Union of Soviet Socialist Republic, United Kingdom, United States of America, and Viet-Nam.

There were also present 12 observers from: UNIDO, UNCTAD, FAO, Economic Commission for Asia and the Far East, EEG, International Institute of Synthetic Rubber Producers, International Rubber Association, Association of Natural Rubber Producing Countries, International Rubber Research and Development Board.

The proceedings of the Assembly were held in private. Two press releases issued: on the first day and a final one.

II. Short summary on the essential items of the agenda

The other items not mentioned here concerned: address of welcome, election of chairman, approval of the agenda, work programme for the Group and the Secretariat, and the next Assembly.

a. Statistics

Two documents (No. 9 and No. 17), the Rubber Statistical Bulletin (Vol. 26, No. 12, Sept. 1972) and many tables with statistics of production and consumption of both natural and synthetic rubber were contributed during the conferences to the delegates and observers.

Although much work had been done to improve the statistics of natural and synthetic rubbers the accuracy of the figures is not satisfactory. This is due to irregular supplying monthly statistical data from many Group Member Countries to the Secretariat and inadequate information. It was also noted that some Group Members were supplying different sets of official data and the Secretariat must seek an explanation which series of figures should be included in the Bulletin. Some Member Countries do not give the figures of re-export of natural rubber and those of consumption of local production and consumption of synthetic rubbers (SR). The Secretariat also cannot get the data from those countries which are not members of IRSG. Under these circumstances the reality of the data is only of 80 - 90 % of the synthetic rubbers production and consumption and of the natural rubber (NR) consumption.

Nevertheless the statistical data presented by the Secretariat of IRSG give the general idea on the trends of production and consumption, the prices, stocks and the development in the countries producing and consuming rubbers.

Supply and consumption of NR and SR in 000000 tons

	<u>1972</u>	<u>1973</u>
NR consumption	3.1	3.3
supply	3.1	3.3
SR consumption	5.4	5.6
supply	5.4	5.8

b. The future of isoprene rubbers

To the isoprene rubbers belong the natural rubber (NR) and the synthetic isoprene rubber (IR)

The 23rd Assembly of IRSG confirmed the conclusion of the 22nd IRSG Assembly in Ottawa, 1971, that foreseen supplies of NR (3-4 million tons) together with existing capacity for synthetic polyisoprene (0.5-0.8 million tons up to 1980) appeared amply sufficient to meet total demand in this period, but the margin of error due to the many imponderables makes any precise estimate impossible.

- c. The survey of NR research and development programmes: For research and development in the field of NR the International Rubber Research and Development Board (IRRDB) was established some years ago. The Board's aim is foster cooperation between member institutes and to provide an organised form for liason and the exchange of technical information.

There are 13 member institutes of IRRDB from nine natural rubber producing contries and IF du Caoutchouc. The member institutes of the IRRDB are associated with territories which are responsible for more than 90% of the world's natural rubber production. The total amounts of funds of all IRRDB members was US.\$ 14,338,000 in 1970. From this sum only 27% were expended for research and development of rubber consumption and 77% of rubber production. In Thailand, Cambodia and Indonesia the total fund was expended only for R and D of rubber production. In the volume of this activity the natural rubber industry is weak relative to the synthetic rubber. Therefore the Assembly of IRRSG recognised as desirable a expendend work in this field with supplementary assistance from the appropriate international organisations.

- d. Report of the Committee of Experts

The progress report of this Committee consists of proposals for consideration by the Committee, and will be reported at the meeting in London in April, 1973. The proposals are dealing with production of NR, processing, marketing and distribution, consumption, and research and development work.

- e. Maritime transportation of NR.

More than 50% of the confernee time was devoted to this item which was included to the agenda at the request of Singapore Government.

The subject is of very great importance to all natural rubber producing countries, especially in the last few months when the price of NR was at a very low level and the freight rates were excessively high. But the shippers have done nothing in the last 30 years to streamline their cargo operations or utilise technical advances in handling cargo. Malaysia maintains e.g. that the NR should be transported by chartered ships or by specially built vessels to carry NR on the outward journey and to bring back suitable cargo on the return journey.

The delegates from the NR consuming countries (Japan, Italy, UK and other) expressed in the discussion the objection to the proposal of the NR producing countries underlining the importance of the regularity of shipment in main producing areas as well as in principal consuming market.

The Assembly of the IRSG noted the vital need for efficient and economical transportation of NR and decided that the Secretary General of the Group should approach UNCTAD and ECAFE with a request to assist in the study of possible alternative modes of maritime transportation of NR.

III UNIDO observer's comments

1. The most important attainments of the 23rd Assembly of the International Rubber Study Group are:
 - Approval and distribution of statistical data concerning the production and consumption of natural and synthetic rubber.
 - The confirmation of the conclusion that the foreseen supplies of NR and the existing capacity of synthetic poly-isoprene are sufficient to meet the total demand of isoprene rubbers in the period to 1980.
 - The statement of the vital need of to decrease the transportation costs of NR.
2. There are important difficulties in the work of IRSG which slacken the rate of development of NR production and consumption. These difficulties are due to:
 - the lack of the real statistical data of production and consumptions.
 - a big competition between synthetic and natural rubbers
 - the very weak activities of natural rubber producing countries in the field of research and development for NR application contrary to the high activity of the producers of synthetic rubber.
 - the threat of increasing production of synthetic isoprene rubber.
3. The countries representing the NR consumers in the IRSG are in general synthetic rubber producers, hence the unity in the Group will be difficult to achieve, therefore there is substantial need to increase the potential of research and development especially for natural rubber application in the natural rubber producing countries.

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THE RUBBER GOODS INDUSTRY IN
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The rubber goods