

THE REPUBLIC OF INDONESIA SURVEY REPORT

ON

**PETROCHEMICAL INDUSTRY
DEVELOPMENT**

VOL. IV SYNTHETIC RUBBER

OCTOBER 1974

Prepared for

**JAPAN INTERNATIONAL
COOPERATION AGENCY**

by

UNICO INTERNATIONAL CORPORATION

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Abbreviations

AB	Alkylbenzene
ABS	Acrylonitrile-butadiene-styrene for polymer
ABS	Alkyl Benzene Sulfonate
AD	Acetic Acid
AG	Aromatic Gasoline (Pyrolysis Gasoline)
BR	Butadiene Rubber
B-B	Butan, Butadiene Residue
BTX	Benzene, Toluene, Xylene
CHP	Cumene Hydroperoxide
CCW	Circulating Cooling Water
CPP	Cast Polypropylene Film
CR	Chloroprene Rubber
C-X(CHX)	Cyclohexane
DEG	Diethylene Glycol
DMT	Dimethyl Terephthalate
DOP	Diethyl Phthalate
E	Ethylene
EG(MEG)	Ethylene Glycol
EO	Ethylene Oxide
EP	Electric Power
EPDM	Ethylene-propylene-diene-methylene Linkage
EDC	Ethylene Di-chloride
EVA	Ethylene-vinyl Acetate Copolymer
FG	Fuel Gas
FO	Fuel Oil
FRP	Fiber Reinforced Plastic
FW	Filtered Water
GP	General Purpose (Polystyrene)
HDPE	High Density Polyethylene
HI	High Impact (Polystyrene)
IR	Isoprene Rubber
IIR	Butyl Rubber
LAB	Linear Alkylbenzene

LDPE	Low Density Polyethylene	
LNG	Liquefied Natural Gas	
LPG	Liquefied Petroleum Gas	
MI	Melt Index	
M-xylene (Xylene)	Mixed Xylene	
NBR	Nitril Rubber	
NG	Natural Gas	
NGL	Natural Gas Liquid	
NR	Natural Rubber	
OPP	Oriented Polypropylene Film	
PP	Polypropylene	
PS	Polysterene	
PTA	Pure Terephthalic Acid	
PVC	Polyvinyl Chloride	
PW	Polished Water	
p-Xylene (P-X)	Paraxylene	
SBR	Styrene-butadien Rubber	
SM	Styrene Monomer	
TPA (TA)	Terephthalic Acid	
UV	Ultra-violet	
VCM	Vinyl Chloride Monomer	
DCF	Discounted Cash Flow	
Exchange Rate	1971	1US\$=360 Yen
		1US\$=415 Rupiah
	After the End of 1973	1US\$=300 Yen
		1US\$=415 Rupiah
GDP	Gross Domestic Product	
GNP	Gross National Product	
IRR	Internal Rate of Return	
\$(DL.)	U.S.\$, unless Particularly Remarkd	
ROI	Return on Investment	

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Chapter 1. Conclusion and Recommendation

It is estimated that synthetic rubber demands in Indonesia in 1980 would be 15,000 tons and 31,000 tons in 1985 respectively, of which SBR in 1980 would be expected to reach 10,000 tons and in 1985 22,000 tons (Table IV-13 in Chapter 3).

Accordingly, viewed from the standpoint of quantity, it is possible to establish a SBR plant during the period from 1980 to 1985 having a minimum production capacity of 25,000 tons. Supposing that a SBR plant with the production capacity of 25,000 tons will have been put to an operation in 1980 and it will have produced a lot matching with the domestic demands, the internal profit ratio of such a plant will be extremely high as much as 23% as reviewed in Chapter 4. However, the material styrene is supposed to be imported and the sales price would be slided in accordance with the rises of commodity prices year after year.

From the above observation, it has been fully cleared that the import-replacing SBR plant construction is sufficiently feasible and viable from the economic standpoint to meet with the domestic demands, thus it is preferable to make a further economic evaluation into this respect inclusive of the possibility of product exports.

Chapter 2. General Introduction

2-1 Background of the Survey and the Purpose

In the Indonesian petrochemical project, possibility of an effective utilization of the by-product butadien, etc. will be determined by economics and the viability of the petrochemical complex in said country.

According to market information obtained recently (Indonesian News, May 30, 1973), it is said that the Indonesian Rubber Production Federation (GPKI) is insisting on the promotion of synthetic rubbers in Indonesia based on the following reasons:

- (1) Indonesia is currently importing large quantities of synthetic rubber materials and products for special usages.
- (2) Through the industrialization of the petrochemical complex, raw materials for synthetic rubber will be produced in quantity.
- (3) World demand for synthetic rubber will ever be increasing, and there will soon be a critical shortage of synthetic rubber materials.

On the other hand, the natural rubber exports of Indonesia hold more than 30% of the total exports except oil enjoying a position of one of the essential primary products. During the 1st-5year development program of Indonesia, the Government there contemplated improvement of natural rubber production, making efforts on cost reduction through increasing production, and is still achieving for the results expected.

In light of the above policies of the Government of Indonesia, all concerned should highly respect said policies and should establish required policies procedures for developing the synthetic rubber industry for all industries requiring the product.

2-2 Policy on the Survey and the Practical Method Adopted

2-2-1 Estimation of the total demand for natural rubber and synthetic rubber

Indonesian total demand for natural rubber and synthetic rubber is estimated until 1985 by the so-called International Cross Section Method using the GDP as the explanatory variable.

2-2-2 Estimation of synthetic rubber demand

Forecasts of synthetic rubber demand were made by estimating the demand structure for major rubber products and the percentage of the market held by synthetic rubber.

2-2-3 Demand estimation on kind-wise synthetic rubbers and the studies on plant economics

While estimating the demand mainly emphasizing SBR, and at the same time, calculations for preliminary plant economics were performed.

Chapter 3. Synthetic Rubber Market Survey and Demand Forecast

3-1 Status on Indonesian Synthetic Rubber Demand

3-1-1 Synthetic rubber imports in Indonesia

Table IV-1 exhibits the statistical tabulation of synthetic rubber in the 1960s viewed from the Indonesian trade statistics. The importation of synthetic rubber started increasing in 1969, and at this time, as given in Table IV-2, the amount of importation from Japan started increasing, which can be seen in Table IV-3 too. During 1972, SBR 932 tons and other synthetic rubbers 666 tons were exported from Japan. Major item for SBR is high styrene, seemingly directed to the production of the sandals.

Table IV-1 Importation of Rubber Materials in Indonesia

	Ton							
	1963	1964	1965	1966	1967	1968	1969	1970
Raw rubber; natural, synthetic, artificial	62	46	25	36	20	30	142	289
Waste of rubber and of rubber substitute	-	-	-	-	-	0	-	44

	CIF 10 ³				US\$			
	1963	1964	1965	1966	1967	1968	1969	1970
Raw rubber ; natural, synthetic, artificial	43	33	16	24	13	13	81	149
Waste of rubber and of rubber substitute	-	-	-	-	-	0	-	6

Source: Indonesian Trade Statics

Table IV-2 Indonesian Importation of Rubber Materials from Japan

	Ton							
	1963	1964	1965	1966	1967	1968	1969	1970
Raw rubber; natural, synthetic, artificial	2	8	2	18	0	3	142	139
Waste of rubber and of rubber substitute	-	-	-	-	-	-	-	-

	CIF 10 ³				US\$			
	1963	1964	1965	1966	1967	1968	1969	1970
Raw rubber; natural, synthetic, artificial	2	5	2	11	0	1	81	72
Waste of rubber and of rubber substitute	-	-	-	-	-	-	-	-

Source : Indonesian Trade Statistics

Table IV-3 Exportation of Synthetic Rubber and Tire from Japan

	Quantity (ton)							Value (10 ³ US \$)						
	1966	1967	1968	1969	1970	1971	1972	1966	1967	1968	1969	1970	1971	1972
Synthetic rubber latex	—	—	—	10	1	—	—	—	—	—	3	1	—	—
Styrene-butadiene rubber	—	—	—	8	127	599	932	—	—	—	3	45	225	309
Synthetic rubber, n.e.s.	14	2	—	17	76	353	666	9	4	—	7	34	167	316
Total	14	2	—	35	203	952	1,598	9	4	—	14	79	392	625
Pneumatic tyres (including tyre flaps) for motor vehicles (brand new)	1,604	5,274	3,510	3,822	4,380	5,057	2,260	1,502	5,059	3,372	3,529	4,334	5,087	2,564
Pneumatic tyres (including tyre flaps) for motor vehicles, excluding brand	13	4	—	4	—	5	—	12	3	—	2	—	1	—
Pneumatic tyres (including tyre flaps) for cycles	99	221	55	33	106	181	51	81	185	50	37	98	185	56
Pneumatic tyres (including tyre flaps), n.e.s.	13	12	—	6	—	6	10	16	11	—	5	1	18	31
Inner tubes for motor vehicles	271	580	252	772	538	481	388	275	581	237	700	549	510	403
Inner tubes for cycles	6	24	9	12	30	30	9	6	26	10	11	31	35	13
Inner tubes, n.e.s.	10	—	—	—	—	2	1	10	1	—	—	—	3	4
Tyres other than pneumatic tyres, for motor vehicles	8	11	2	6	9	18	3	9	14	2	11	15	24	5
Tyres other than pneumatic tyres, for cycles	16	12	—	—	—	2	—	12	12	—	—	—	3	—
Tyres, n.e.s. and interchangeable tyre treads	—	7	10	1	42	2	5	—	17	39	1	65	10	11
Total	2,039	6,146	3,839	4,657	5,106	5,784	2,729	1,924	5,909	3,711	4,298	5,092	5,876	3,087

3-1-2 Indonesian tire industry

A summary is given below on the tire industry which is the typical demanding industry for the synthetic rubber:

(1) Automotive tire production in Indonesia

In Indonesia there are 3 tire manufacturers at present:

P.N. Intirub
P.N. Palembang
P.T. Goodyear Tire & Rubber Co., Ltd.

(a) P.N. Intirub

This company owns its plant in Jakarta founded in 1958, utilizing equipments made in Czechoslovakia and East Germany. It presently has a daily production capacity of 600 tires, which will be increased to 1,000 tires/day capacity by 1975. In 1971 it completed negotiations with Goodyear Tire, on a Management-Technical Assistance Agreement with 5-year effectivity.

(b) P.N. Palembang

This plant in Palembang was established in 1958, but has recently begun production with 550 tires/day production capacity and is scheduled to increase its production capacity up to 630 tires/day by 1975. In 1971 it also completed negotiations with Goodyear Tire on a Management-Technical Assistance Agreement with 5 year effectivity.

(c) Goodyear Tire & Rubber Co., Ltd.

This is the joint venture company between Goodyear International and Goodyear Akron, having its plant in Bogor starting up its operations in 1935. During the period from March 1965 to April 1967, for approximately 2 years, the plant was taken over by the Government of Indonesia. When the plant was released, Goodyear started rearrangement and expansion programs finishing its 1st expansion program at the end of 1971 with a production capacity of 2,275 tires/day, which is scheduled to become 4,000 tires/day in 1976 when the 3rd expansion program will have been completed. In accordance with the agreement concluded with Dunlop, 25% of the total production is being marketed under the brandname of Dunlop.

Totalling the above three companies' production actuals and expansion programs, Table IV-4 results, viz., 725,000 tires in 1972, 1,080,000 tires in 1973 according to the estimation.

When currently projected expansion programs will have been completed in 1976, the production will be approximately 1,700,000 tires per annum.

(2) Importation of tires

The importation of tires to Indonesia was almost completely banned in 1971 by the Government. However, due to the shortage of tires, importations were still carried out through special permission of Government authorities.

Table IV-4 Production of Tires in Indonesia
(Excluding Motorcycles and Bicycles)

	1968	1969	1970	1971	1972	1976 (estimate)
Goodyear	220,100	220,100	323,600	368,600	514,700	1,180,000 ¹⁾
Intirub	n.a.	14,800	39,100	72,300	161,400	300,000 ²⁾
Palembang	-	-	-	11,400	48,600	188,000 ³⁾
Total	-	234,900	362,700	452,300	724,700	1,668,000

Source: Central Bureau of Statistics of Indonesia

Notes : 1) 4,000/day (1973: 2,450/day)

2) 1,000/day (1973: 600/day)

3) 630/day (1973: 550/day)

In Table IV-5 exhibitions were made on tire importations according to the statistics prepared by the Indonesian Government, and in Table IV-6 the importations made only from Japan out of Table IV-5. In Table IV-3, the tire exports from the Japanese export statistics are being extracted for our reference, where the reductions of imports during 1968 are a result of the import ban for the main tire dimensions, 600-16, 650-16, 670-15, and 750-20; and, moreover, the reason for the decrease again in 1972 is presumed to be the import ban in 1971 mentioned above.

Table IV-5 Importation of Tires in Indonesia

Commodity	Number 10 ³							
	1963	1964	1965	1966	1967	1968	1969	1970
Tyres, for motorcars, cover	285	313	812	113	455	286	503	443
Tyres, for motorcars, tubes	148	317	186	139	355	160	282	414
Tyres, for Motorcycles, cover	65	101	122	188	135	86	202	212
Tyres, for motorcycles, tubes	67	75	71	144	124	123	204	328
Tyres, for othercycles, cover	2,801	990	666	1,020	2,698	588	656	410
Tyres, for othercycles, tubes	281	231	80	40	744	141	201	114

Commodity	Ton							
	1963	1964	1965	1966	1967	1968	1969	1970
Tyres, for motorcars, cover	6,866	6,007	14,175	19,930	6,146	4,268	3,997	7,746
Tyres, for motorcars, tubes	454	962	451	311	826	361	595	868
Tyres, for motorcycles, cover	169	115	264	285	332	204	415	389
Tyres, for motorcycles, tubes	48	49	46	92	74	97	125	176
Tyres, for othercycles, cover	2,476	821	591	825	2,190	459	572	326
Tyres, for othercycles, tubes	99	98	188	16	341	41	146	34

Commodity			CIF 10 ³		US\$			
	1963	1964	1965	1966	1967	1968	1969	1970
Tyres, for motorcars, cover	26,343	21,146	20,108	9,438	6,730	4,480	3,996	4,886
Tyres, for motorcars, tubes	400	784	421	462	798	326	609	728
Tyres, for motorcycles, cover	229	309	351	427	383	226	456	421
Tyres, for motorcycles, tubes	62	52	58	166	83	86	130	187
Tyres, for othercycles, cover	2,045	778	493	1,236	2,150	460	447	234
Tyres, for othercycles, tubes	89	84	32	23	188	35	51	28

Table IV-6 Indonesian Importation of Tires from Japan

Commodity			Number 10 ³					
	1963	1964	1965	1966	1967	1968	1969	1970
Tyres, for motorcars, cover	140	256	738	81	383	266	487	412
Tyres, for motorcars, tubes	80	242	131	110	308	142	264	395
Tyres, for motorcycles, cover	17	66	31	34	64	46	158	153
Tyres, for motorcycles, tubes	23	38	10	45	70	76	179	274
Tyres, for othercycles, cover	708	167	17	40	455	97	103	8
Tyres, for othercycles, tubes	68	114	12	6	110	28	17	9

Commodity			Ton					
	1963	1964	1965	1966	1967	1968	1969	1970
Tyres, for motorcars, cover	3,561	2,820	2,552	19,301	4,999	3,863	3,676	7,298
Tyres, for motorcars, tubes	249	765	276	228	738	318	555	807
Tyres, for motorcycles, cover	60	43	93	89	162	131	337	282
Tyres, for motorcycles, tubes	18	27	7	38	45	58	113	149
Tyres, for othercycles, cover	622	150	12	33	376	459	572	7
Tyres, for othercycles, tubes	21	40	164	2	35	8	66	4

Commodity			CIF 10 ³		US\$			
	1963	1964	1965	1966	1967	1968	1969	1970
Tyres, for motorcars, cover	3,885	6,006	18,046	8,470	5,119	3,868	3,568	4,259
Tyres, for motorcars, tubes	197	550	276	371	619	263	550	655
Tyres, for motorcycles, cover	70	51	104	102	177	119	363	308
Tyres, for motorcycles, tubes	19	26	7	37	43	57	117	162
Tyres, for othercycles, cover	546	147	12	30	346	62	87	6
Tyres, for othercycles, tubes	38	54	21	2	27	7	13	4

Source : Indonesian Trade Statistics

(3) Tire demand

As given in Table IV-7, the actual past demands for automotive tires in Indonesia have shown an average increase of 13% per annum and it is estimated that in 1972 it must have exceeded more than 1,000,000 tires.

Table IV-7 Apparent Consumption of Tires in Indonesia Unit: 10³ pieces

	1969	1970	1971	1972	
Production	236	363	452	725	
Importation	503	443	500	335 ¹⁾	
Apparent consumption	739	806	952	1,060	
Increasing rate (%)	-	9.1	18.1	11.3	(Av. 12.8%)

Source: Table 3, Table 4 and Table 5

Notes: 1) $2,260 \times 10^3 / 7.5 \times 1/0.90 = 335 \times 10^3$

Average unit weight of tire is assumed as 7.5 Kg

(4) Bicycle tire

As shown in Table IV-8, the actual past production of bicycle tires in Indonesia is about 2,160,000 pieces per annum.

Table IV-8 Trend of Bicycle Tires and Tubes Production in Indonesia

Year	Tyres (piece)	Tubes (piece)	Remarks
1966	1,414,651	151,650	Only from PT GOOD YEAR, while from other factories not available
1967	1,951,390	174,442	
1968	1,702,518	211,678	
1969	1,728,637	129,656	
1970	3,634,000	6,018,000	For all factories in Indonesia
1971	2,548,774	2,659,662	

Notes:

- 1) Use of synthetic rubber:
 1. For tyres, average use 10% by weight.
 2. For tubes, average use 6% by weight.
- 2) Weight of tyres and tubes:
 1. Average weight of one piece tyre: 1.06 kg.
 2. Average weight of one piece tube: 0.34 kg.

3-2 Forecast of Indonesian Rubber Demand

Before proceeding with synthetic rubber demand, the overall

demand estimations on the macroscopic basis has been done, and next, the same has been done on automotive tires which create the biggest demand on synthetic rubber, and rubber demand required for the production thereof.

3-2-1 Macroscopic demand forecast of rubber

Through the Cross Section Method, calculations of 15 countries' per capita rubber consumption and similarly per capita gross domestic product. Data was quoted from the United Nations 1970 statistics. Said per capita rubber consumption and gross domestic products are given in Table IV-9, thus the following regression equation:

Table IV-9 Per Capita Rubber Consumption and Per Capita Gross Domestic Product (1970)

	Per capita rubber consumption	Per capita GDP ²⁾
	Kg	US \$
Argentina	1.3	794
Australia	7.2	2,504
Belgium-Luxemburg	6.7	2,020
Brazil	1.3	317
Canada	7.2	2,910
France	8.2	2,450
Germany, Fed. Rep.	9.5	2,267
India ¹⁾	0.2	77
Italy	5.8	1,326
Japan	7.5	1,527
Netherlands	3.7	2,445
South Africa	2.0	623
Sweden	9.2	3,710
United Kingdom	8.3	1,842
United States	12.3	3,817

Notes: 1) 1969
2) 1965 constant price

$$\log q = 0.4983 + 0.9987 \log u$$

where, q: per capita rubber consumption (kg)

u: per capita gross domestic product (US\$1,000)

Correlation coefficient is 0.9489 which shows considerably higher

correlation. As seen from this equation, a nearly linear relation is formed between per capita rubber consumption and per capita gross domestic product, the relation of which is shown in Figure IV-1.

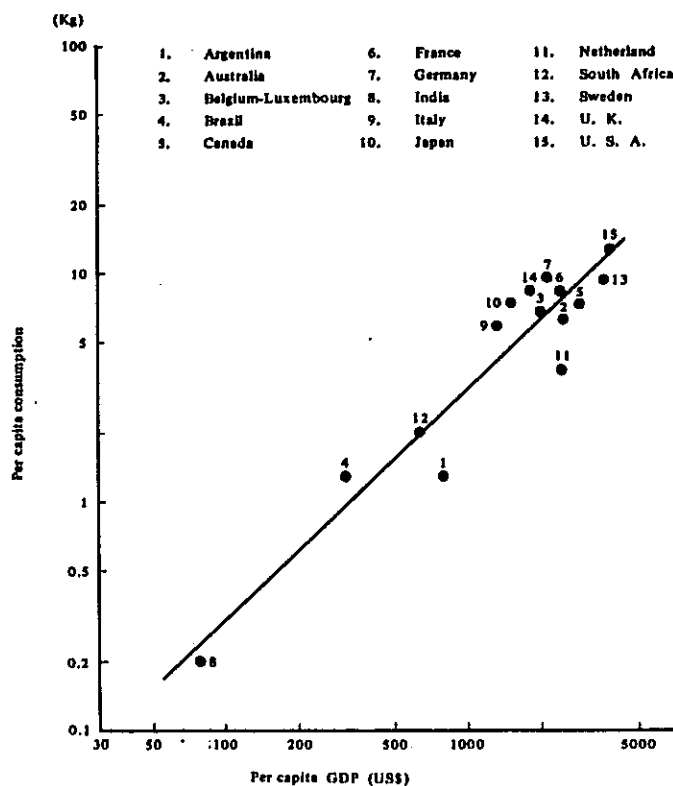


Figure IV-1 Relationship between Per Capita GDP and Per Capita Rubber Consumption

The population and gross domestic product of Indonesia in 1980 and 1985 are estimated in Table IV-10, from this table calculations of total rubber demand in 1980 and 1985 are shown in Table IV-11. Incidentally, the estimation on the total 1973 rubber consumption will result 0.4 kg for the per capita consumption* and 52,000 tons in total which exceeds the FAO forecast of 40,000* tons by over 30%. When the gross domestic product increases after 1980, reliability of calculations will become higher.

3-2-2 Demand forecast of automotive tires

In making the demand forecast of automotive tires, it is necessary firstly to make the demand forecast of the automobile and then accumulate by the types of the tires required. However, for the present survey there was no adequate time to acquire detailed and accurate information on the automobiles, thus another method was adopted for the forecasting of tires alone.

As mentioned earlier, demand for automotive tire is being risen at an average annual rate of 13% since 1969, this trend may continue for several years to come.

Supposing that an annual rate of 13% increase will be

Note: * FAO, GM/88/STAT/REP, 7th June, 1973

Table IV-10 Assumption of Gross Domestic Product in Indonesia

	1970 (Actual)	1975	1980	1985
GDP (1960 constant price) (10 ⁹ Rp.)	548.4			
Growth rate of GDP (%)		7.2	8.3	8.5
GDP (1960 constant price) (10 ⁹ Rp.)		776.4	1,156.7	1,739.3
GDP (1965 constant price) (10 ⁹ Rp.)	13.74	19.42	29.00	43.59
Population (Million)	121.1			
Growth rate of population (%)		1971 2.7 1975 2.5	1976 2.4	2.0
Population (Estimated) (10 ⁶)		137.9	153.8	169.8
Per capita GDP (US \$)	113.5	140.8	188.5	256.7

Table IV-11 Predictions of Rubber Consumption in Indonesia

	1975	1980	1985
Percapita rubber consumption (kg)	0.44	0.58	0.79
Total rubber consumption (10 ³ tons)	60.7	89.2	134.1

maintained until 1980 and that it will drop only to 10% after 1981, then the predicted results in Table IV-11 will apply. Automotive tire demand in 1980 is to be 2,800,000 and in 1985 it will be 4,500,000 of which half will be for passenger cars, remaining will be for trucks and buses, the required rubber quantity will be approximately 10 kgs per one tire. Rubber consumption for automotive tires in 1980 and 1985 will be, respectively, 28,000 tons and 45,000 tons, which correspond to 32% and 34% of the total rubber consumption in Indonesia as given in the preceding paragraph.

Annex III shows the Japanese rubber consumption structure. Accordingly rubber consumption for Japanese automotive tires (inclusive of tubes) was 452,000 tons in 1972 sharing 51% of the total rubber consumed. Indonesian automotive rubber consumption is comparatively small, but in view of the fact that Japanese cars and tires are being exported to overseas countries and that there still exists in Japan a brisk demand of tires for repair, the ratio of 32 - 34% may not necessarily be so small if Indonesian demand is considered to come from domestic demand alone.

3-3 Forecast of Indonesian Synthetic Rubber Demand

The extent of replacement of natural rubber by synthetic rubber will not only be affected by the mechanical properties, other

qualitative characters, prices and the technical level of the processors of natural and synthetic rubbers, but also will greatly be influenced by the Government's policies, thus a purely objective forecast is extremely difficult.

Therefore, taking into consideration of the situation in advanced industrial countries, Europe and the U.S.A. (Annex I and II), situation in Japan (Annex III), presumably the most appropriate consumption rate of synthetic rubber was estimated and thus the demand for synthetic rubber in Indonesia was forecast.

In view of the reasons given in the preceding paragraph, the results of the present forecast will have to be reviewed in the near future in more detail.

3-3-1 Automotive tires

Goodyear Tire & Rubber Co. is using 15% of synthetic rubber consumed and it is understood that Goodyear is trying to make it to 30%. Subsequently, as given in Table IV-12, supposing that the switchover to synthetic rubber will have been 15% until 1977, 30% in 1981 and thereafter, then the quantity of synthetic rubber will be 5,600 tons in 1980, 13,600 in 1985, of which supposing that 70% would be of SBR products, the demand will be respectively 4,000 tons and 9,500 tons.

Table IV-12 Prediction of Tires and Synthetic Rubber Consumption for Motor Cars

	Number 10 ³	Rubber Consumption 10 ³ tons	Synthetic Rubber %	Consumption tons
1972	1,060	10.6	10	1,060
1973	1,198	12.0	10	1,200
1974	1,354	13.5	10	1,350
1975	1,529	15.3	15	2,300
1976	1,728	17.3	15	2,600
1977	1,953	19.5	15	2,900
1978	2,207	22.1	20	4,420
1979	2,498	24.9	20	4,980
1980	2,818	28.1	20	5,640
1981	3,100	31.0	30	9,300
1982	3,410	34.1	30	10,230
1983	3,751	37.5	30	11,250
1984	4,126	41.3	30	12,390
1985	4,538	45.4	30	13,620

3-3-2 Bicycle tires

Approximately 1 kg of rubber is consumed for a bicycle tire and of which 15% is synthetic rubber. Supposing that all of synthetic rubber is SBR, present SBR consumption for bicycle tires in Indonesia is estimated to be about 375 t/y.

About a half of bicycle tires is produced by P.T. Goodyear Tire & Rubber Co., Ltd. and another half is by many companies including small sized firms.

Table IV-13 shows present production capacity of bicycle

tires of each firm except Goodyear Tire & Rubber Co. Total production capacity is as big as ten times of present production amount, and it seems that bicycle tires are manufactured by those firms mentioned in Table IV-13 together with other rubber products. Therefore, prediction of bicycle tires production and synthetic rubber consumption thereto was included into the general industrial fields described in the next paragraph.

Table IV-13 Production Capacity of Bicycle Tires and Tubes in Indonesia

Name of Firms	Address	Production Capacity	
		(Tires)	(Tubes)
<u>D.K.I. Jakarta</u>			
1. P.T. Gajah Tunggal	Jl. Bandengan Utara no.37/75	504,000	-
2. P.T. Singa Sakti Rub Fact	Jl. Gedong Panjang No.38	252,000	378,000
3. P.T. Jawa Rubber Fab	Jl. Pasar Minggu	1,159,000	-
4. Indra Mas	Jl. Jembatan Lima 13	352,800	-
5. Golden Star	Jl. Bandengan Utara 71	554,400	-
6. King Kong	Jl. Kramat Raya 157	-	2,079,000
7. Victor Factory	Jl. Tiang Bendera 54	-	1,134,000
8. N.V. Sparta	Jl. Jendral Soedirman Gg II	-	1,134,000
9. International	Jl. Bandengan Utara 99	-	819,400
10. Roda Mas Rubber Goods Fac.	Jl. Bandengan Utara 91	604,800	1,134,000
<u>West Java</u>			
1. N.V. Kali Baru	Jl. Arjuna 48 Banjung	226,800	680,400
2. Hevea Latex	Jl. Pekalongan 22-24 Cirebon	176,400	642,600
3. P.T. Mutu Mas	Jl. Sukosari 34 Bogor	-	907,200
4. P.T. N i p i	Jl. Talang 4 Cirebon	100,800	453,600
5. N.V. Pertija	Bandar Pete Ciawi Bogor	-	2,189,000
6. P.T. Malinggul	Jl. Abrama Pal. Ia Bogor	352,800	-
<u>Central Java</u>			
1. P.T. Asri	Jl. Blutan 71 Pemalang	25,200	756,000
2. Tirto	Jl. Kraton Lor 1/103 Pekalongan	630,000	94,500
3. Wates Sun	Jl. Perkutut 11-13 Semarang	126,000	75,600
4. P.T. Mega Rubber	Jl. Banyu Malik 92 Somarang	830,000	-
<u>East Java</u>			
1. P.K. Indonesia	Jl. Dupak 61 Surabaya	3,024,000	-
2. Fa. Ganefo	Jl. Ngagel 79 Surabaya	504,000	-
3. New Indonesia Rub.	Jl. Dr. Cipto Bedali Lawang	252,000	-
4. Njoo Kim	Jl. Belakang Penjara Surabaya	352,000	-
<u>North Sumatra</u>			
1. New Asian Rub.	Jl. Cirebon 77 Medan	630,000	907,200
2. Timur Raya	Jl. Thamrin 102 Medan	201,600	-
3. Fa. Mulia Raya	Jl. Kereta Api 10 Medan	428,400	74,600
4. Bukit Naga	Jl. Rangka 46 Medan	403,200	604,800

Source: Department of Light Industry (August, 1974)

3-3-3 Footwear, etc.

In the general industrial and non-industrial fields including footwear, about 20% is being switched over to synthetic rubber, of which 60% is SBR, the remaining is other miscellaneous synthetic rubber, and trial calculation results are in Table IV-14.

Table IV-14 Prediction of Synthetic Rubber Consumption in Indonesia

(Unit: 10³ tons)

	1975			1980			1985		
	Total rubber	Synthetic rubber	SBR	Total rubber	Synthetic rubber	SBR	Total rubber	Synthetic rubber	SBR
Tires for motor cars	15.3	2.3	1.6	28.2	5.6	4.0	45.4	13.6	9.5
Other application	43.4	4.3	3.0	61.0	9.2	6.4	88.7	17.7	12.4
Total	60.7	6.6	4.6	89.2	14.8	10.4	134.1	31.3	21.9

3-3-4 Summarization

Summarizing the above, demand for synthetic rubber in 1980 will be 14,800 tons, of which SBR will be 10,400 tons; and, in 1985 it will amount to respectively 31,300 tons and 21,900 tons. As a result, the rate of switchover to synthetic rubber will be 17% and 23%, respectively.

On the other hand, the demand for natural rubber will be respectively about 70,000 tons and 100,000 tons, thus at this point the availability in quantity and quality of the natural rubber to be directed to the domestic consumption will become a big problem. For reference, statistics of production and export of natural rubber from Indonesia during the past several years are given in the Table IV-15.

Table IV-15 Production, Exportation and Apparent Domestic Consumption of Natural Rubber in Indonesia

Unit: 10³ tons

	Production			Exportation			Balance ²⁾
	Estate	Smallholder	Total	Estate	Smallholder	Total	
1966	208.8	528.0 ¹⁾	736.8 ^{b)}	238.0	441.9	679.9	56.9
1967	198.6	500.3 ^{a)}	698.9	211.3	440.2	651.5	47.4
1968	207.5	531.2 ^{a)}	738.7	229.9	541.0	770.9	▲ 32.2
1969	222.7	558.0 ^{a)}	780.7	229.2	626.6	855.8	▲ 75.1
1970	238.2	571.0 ^{a)}	809.2	233.5	556.9	790.4	18.8
1971	238.4	572.8 ¹⁾	811.2 ^{b)}	233.4	555.9	789.3	21.9
1972	238.8	601.2	840.0 ^{b)}	217.7	518.4	736.1	103.9

Source: Indikator Ekonomi Juli 1973

a) FAO

b) UN Monthly Bulletin of Statistics *XXVII*, (11), (Nov. 1973)

Notes: 1) Balance of total and estate

2) Balance of production and Exportation

Supposing that there might be some problems in production and distribution of natural rubber, it will certainly become mandatory to increase the production of synthetic rubber to alleviate the tight situation of the demand/supply balance.

Chapter 4. Economic Calculation for SBR Plant

4-1 Process Description

4-1-1 Licensor list

- a) Japan Synthetic Rubber
- b) Phillips Petroleum
- c) Shell
- d) Dow Chemical
- e) Hüls
- f) Uniroyal
- g) ICI
- h) Firestone Tire and Rubber
- i) Polysar (UK)

4-1-2 Process description

The synthetic rubber, SBR, production process by low-temperature continuous polymerization from styrene and butadiene comprises monomer tank, chemical preparation, polymerization reaction, recovery and finishing processes - altogether 6 steps.

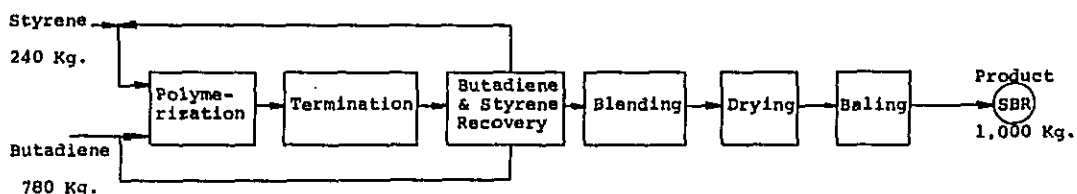


Figure IV-2 Process Flow Diagram

a) Monomer tank & chemicals preparation

Styrene and butadiene have greater reactivity requiring sufficient cares in the handling and storage, that is, antipolymerization agent must be put into styrene and butadiene for the stabilization, and then it must be put into storage tank. On the occasion of the polymerization, carry out alkali cleansing, remove the added antipolymerization agent, and feed it into reactor. At the chemicals preparation section, prepare the emulsifier, activator, oxidizer, polymerization terminating agent, oil and anti-oxidant.

b) Polymerization process

Polymerization section consists of 8 - 12 reactors, 8 - 12 polymerizing termination towers, and several surge tanks.

Feedstocks and other auxiliary feedstocks are being fed into reactor through the cooler. Polymerizing reactor is usually equipped with an agitator and it is a drum with a glasslining. When a desired conversion rate is reached by the reactor, the reacting liquid is being sent into the polymerization terminating tower, added with polymerization terminating agent, and is sent to the Latex surge tank.

c) Recovery process

The reacting liquid to be reacted is sent in from the

above Latex surge tank and is put to the recovery process; firstly unreacted butadiene is recovered, and then unreacted styrene. The former recovery yield is about 98.5 - 99%, and the latter 98 - 98.5%.

d) Finishing process

Latex that has come from the styrene stripper is being agitated by blending tank uniformly, then antioxidant, creaming agent, coagulant are added in these orders, and sent out to the coagulating bath.

Furthermore, the Latex will be processed through conversion, washing, filtrating, crushing, drying by the dryer, baling machine, and will be finally packed to a required form.

4-2 Basic Data for Economic Calculation

4-2-1 Construction and operational planning

Domestic demand for SBR in Indonesia is being estimated to be 10,000 t/y in 1980 and 22,000 t/y in 1985. Therefore, a plant having capacity of 25,000 t/y is assumed to be constructed in accordance with the following plan:

Start of construction	July, 1977
Completion of construction	June, 1979
Initial startup and preparations	July - December 1979
Operational startup	January, 1980

4-2-2 Process data

Plant process data are as follows:

(1) Unit consumption of raw material unit

Butadiene	0.78
Styrene	0.24

(2) Consumption of utilities

Electricity	500 KWH/t
Steam	2 t/t
Cooling water	300 t/t
Pure water	14 t/t

(3) Others

Catalyst and chemicals	152 * \$/t
Packaging cost	21 * \$/t

(4) Operation manpower 84 persons/y

4-2-3 Total investment

Total investment calculated by values at the time of startup.

Note: * Price at the time of operational startup

	<u>10⁶ US\$</u>
(1) Production facilities acquisition price	27.7
(2) Auxiliary facilities acquisition price	8.3
(1) x 0.30	
(3) Operation preparatory cost material cost, utilities loss and personnel cost during the test operation	1.3
(4) Monetary interest during construction period, 7.5%/y x 1 year	2.8
<hr/>	
A Total fixed capital	40.1
B Operation capital *	3.1
<hr/>	
C Total investment amount	43.2

Note: * Funds required for 2 months stock of raw materials, accounts receivable, and 90 days of accounts payable period.

4-2-4 Product prices and variable cost

Product prices and variable cost as calculated by the 1980 price are given below. Product prices were taken from Table IV-16 (1), material price and utilities cost from Volume II, Part 3, and styrene shall be imported, the estimated prices are described in Table IV-16 (1).

(1) Product price (US\$/t)		
SBR	1,160	
(2) Material price (US\$/t)		
Butadiene	135	
Styrene	640	
(3) Prices on utilities		
Electricity	0.0583	\$/KWH
Steam	4.6	\$/t
Cooling water	0.004	\$/t
Pure water	0.014	\$/t

4-2-5 Fixed cost calculation method

(1) Depreciation cost

Total fixed asset is assumed to be depreciated in 10 years by the straight line method and also assumed that there will be no residual value.

(2) Repair & maintenance costs

3% (annual) of the acquired price of production facilities.

(3) Taxes, public dues and insurance premiums

1% (annual) of the residual value (book value) of the depreciation balance of the production and auxiliary facilities acquired prices.

(4) Monetary interest

70% of the total fixed capital will be a loan, and the interest rate shall be 7.5% per annum.

Operational fund will be totally borrowed at an interest rate of 12% per annum.

(5) Wages

Average wages per person/year is US\$2,242 in 1980.

(6) Miscellaneous expenses

Will be the same as annual wages.

(7) Administration cost

3% (annual) of the total sales amount.

4-2-6 Premises of economic calculations

(1) Repairs and maintenance costs, wages and miscellaneous costs, out of the plant shipment price, variable cost factor and fixed cost factor are assumed to rise by 7% a year, thus the economic calculations were performed.

(2) Loans shall be left unredeemed for 5 years (which is equivalent to a 3-year period after startup), and shall be refund on equal installment over a period of 7 years.

(3) Corporate taxes are exempted for 5 years after the startup, and thereafter shall be 45% of the gross before tax profit from the 6th year.

(4) All products shall be directed to the domestic market, and the following operational ratio is assumed.

<u>Year</u>	<u>Stream Factor</u> (%)	<u>Production</u> (t/y)
1980	50	12,500
1981	60	15,000
1982	70	17,500
1983	80	20,000
1984	90	22,500
1985	100	25,000
1986	100	25,000
1987	100	25,000
1988	100	25,000
1989	100	25,000

(5) Internal rate of return (IRR) is calculated by the following equation:

$$F + W = \sum_{t=1}^n \frac{R_t}{(1+r)^t} + \frac{W}{(1+r)^n}$$

where:

- F: Total fixed capital
- W: Working capital
- t: Number of years, taking the startup year as 1
- n: Economic calculation duration. On this occasion 10 years.
- R_t: Return at the 't' year(s), viz.,
(total annual sales) - (annual total cost)
However, the internal return ratio calculation under its accounting subject of annual costs does not include depreciation cost and monetary interest.

4-3 Result of Economic Calculations

Calculation results are given in Table IV-16(2)

As described earlier, the plant stream factor for 1980 was assumed to be 50%, and 100% after 1985, and during said period the rate will be improving by 10% each year, thus while the initial stream factor is low the internal rate of return is considered high maintaining 23%. Internal rate of return and cost accounting results are given in Table IV-16.

Table IV-16(1) The Calculation of DCF Rate of Return on Investment
Operation start in 1980

YEAR	INVESTMENT	CURRING CAPITAL	INCOME BEFORE TAX	INCOME AFTER TAX	INTEREST	DEPRECIATION	NET CASH FLOW	DISCOUNT RATE	(CASH) PRESENT VALUE	(INV.) PRESENT VALUE
0	24265	2484	0	0	0	0	0	1.0000	0	26749
1	0	0	1567	1587	1572	2427	5586	0.8334	4655	0
2	0	0	1939	1939	1473	2427	5888	0.6946	4090	0
3	0	0	2659	2659	1373	2427	6459	0.5788	3739	0
4	0	0	3142	3142	1274	2427	6942	0.4824	3301	0
5	0	0	3970	3970	1092	2427	7499	0.4020	3010	0
6	0	0	4586	2068	910	2427	5864	0.3351	1965	0
7	0	0	5234	2400	728	2427	6088	0.2792	1700	0
8	0	0	6171	2777	546	2427	6366	0.2327	1482	0
9	0	0	6974	3138	364	2427	6626	0.1940	1285	0
10	0	-2434	7867	4327	162	2427	6935	0.1616	1121	-402
IOI	24265	0	44287	30364	9514	24265	44143	0.4108	26348	26347

Notes: SBR price forecast

Similar price forecasting method was adopted from Annex II part I of this report.

(1) Unit consumption

Styrene unit as against SBR	0.24
Butadiene unit as against SBR	0.78
Ethylene unit as against styrene	0.313
Benzene unit as against styrene	0.841

(2) Exfactory prices on raw materials and products in Japan

	1971	1974
Ethylene	30.0	75.6
Butadiene	28.0	42.3
Benzene	24.1	63.9
SBR	168.3	-

(3) Model of Japan exfactory price

$$P_n = 5.69(1.015)^{n-4} + 12.89(1.032)^{n-4} + 7.58(1.043)^{n-4} + 33.0(1.046)^{n-4} + 131.75(1.053)^{n-4}$$

where 'n' stands for the number of years making 1971 as 1.

Table IV-16(2) Cost Estimation Data of SBR in 1980

PRODUCT	SBR			25,000 (t/y)		
PLANT CAPACITY				25,000 (t/y)		
ANNUAL PRODUCTION				12,500		
TIME OF CONSTRUCTION				1977, 06		
STREAM FACTOR				0.500		
INVESTMENT						
PROCESS PLANT				27700 (\$)		
OTHER ASSETS				8300		
PRE-OPE. EXPENSE				1253		
INTEREST DUR CONSTR				2794		
*FIXED CAPITAL				40047		
*WORKING CAPITAL				3094		
TOTAL INVESTMENT				43141		
PRODUCTION COST					(Unit: 10 ³ US\$/t)	
	UNIT CONS/PROD	UNIT PRICE	ANNUAL QUANTITY	ANNUAL COST		UNIT COST
BUTADIENE	0.78 (t/t)	0.135	9750	1316		0.11
STYLENE	0.24 (t/t)	0.6	3000	1920		0.15
RAW MATERIAL & BY-PRODUCTS				3236		0.26
POWER	0.5 (KWH/t)	0.058	6250	364		0.03
STEAM	2.0 (t/t)	0.0046	25000	115		0.01
C.W.	0.3 (10 ³ t/t)	0.040	3750	150		0.01
P.W.	0.014 (10 ³ t/t)	0.452	175	79		0.01
BAG	1	0.021	12500	262		0.02
CHEM	1	0.152	12500	1900		0.15
UTILITIES				2871		0.23
*VARIABLE COST TOTAL				6107		0.49
WAGES				188		0.02
REPAIRING COST				831		0.07
DEPRECIATION				4005		0.32
FIXED ASSET TAX				400		0.03
GENERAL OVERHEAD				188		0.02
OTHER FIXED COST				137		0.01
FIXED COST TOTAL				5750		0.46
TOTAL SALES COST				435		0.03
TOTAL COST				12292		0.98
PROFIT & LOSS				2208		0.18
SALES TOTAL				14,500		1.16
R.O.I. (NET PROFIT BEFORE TAX/TOTAL INVESTMENT)				0.0512		
I.R.R. (INTERNAL RATE OF RETURN ON INVESTMENT)				0.2322		

ANNEX I. Comparisons between Natural and Synthetic Rubber

I-1 Comparisons between Natural and Synthetic Rubber

I-1-1 Comparison of processability between natural and synthetic rubber

Required differences of processing techniques of natural and synthetic rubbers are shown in Table AIV-1

I-1-2 Comparisons of performance of NR and major SR

Comparisons of performance of natural and synthetic rubber are respectively given in the Tables AIV-2 and AIV-3.

I-1-3 Comparisons of usage of synthetic rubber in Japan

(1) Tires

1) Truck, bus and other heavy load tires

Because of exothermicity, chipping and cutting problems, use of synthetic rubber is still low. The rates are 30% for 1970, 33% for 1971, and 34% for 1973, thus remaining constant; major items are SBR and BR, but the growth of IR is remarkable.

2) Passenger car, small-size trucks, motor cycle, bicycles and other light duty tires

Compared with heavy duty tires, the rate of usage of synthetic rubber is extremely high, viz., 75%. SBR and BR are the major items, but the rapid growth of IR and EPDM cannot be overlooked.

3) Characteristics of different rubber materials used in tires.

NR: Tear strength is excellent and cut resistance is high, and the exothermic volume is small, Strength is great.

SBR: Thermo-aging is small, highly wear resistance. Defect - low cut resistance.

BR: Highly crack resistance, highly wear resistance. Defect - Chips easily with low cutting resistance.

IR: Similar to the above NR.

EPDM: Blended items are being utilized for better weather resistance.

(2) Tubes

1) In 1973, percentage of synthetic rubber was 96%, followed by IIR with 86%, and good growth of EPDM to 13%.

2) Characteristics of rubber for tube

IIR: Leak resistance
Resists aging

Table AIV-1 Comparison of Processing Techniques of Natural Rubber and Synthetic Rubber

Processing Condition	Natural rubber	Synthetic rubber
Material rubber:		
Components	Constant	Many kinds
Quality fluctuation	Considerably non-uniform	Almost constant
Stability in storage	Stable	A little unstable
Mastication work:		
Easiness of the work	Easy	Difficult
Exotherming	Low	High
Peptizer	Effective	Not so effective
Optimum mastication	Low-temperature mastication(roll)	High-temperature mastication by Banbury (mixer)
Mastication back	None	There is
Compounding work:		
Dispersion	Easy	Difficult
Compounding sequence	Ordinary	A little restricted
Process oil	Small amount	Great amount
Hardening rubber material:		
Shrinkage	Small amount	Great amount
Adhesion	Great (big) (wet)	Small (dry)
Powder beating	Many	Small
Building	Easy	Difficult
Calendering work:		
Temperature	High	A little low
Surface	Good	A little poor
Shrinkage	Small	Large
Bubbling	Normal	Difficult to take out
Extrusion work:		
Temperature	High	A little low
Screw depth	Deep	Shallow
Revolution speed	Fast	Slow
Curing:		
Temperature	Low - high	High (more than 155°)
Speed	Fast	Slow
Strength at a high temperature	No great change compared with normal temperature	By far weak than the normal temperature
Bubbling	Normal	Difficult to take out
Effect by reinforcing agent	1.1 - 1.6 times	5.0 - 10.0 times

Table AIV-2 Comparison of Characteristics of Major Synthetic Rubber

Polymer	NR	IR	SBR	BR	NBR	EPDM	IIR	CR
Specific gravity	0.92	0.91	0.94	0.91	0.98	0.86	0.92	1.23
Curing speed	fast	fast-medium	med.	med.	med.	slow	slow	med.
Green strength	□	△~X	△~X	X	△	△~X	△~X	□~△
Mechanical strength	□	□	□	△	□	△	△~X	△
Resiliency	□	□	△	○	△~X	△	△~X	△~X
Exotherm	□	□	△	○	△~X	△	X	△~X
Compression set	□	□	○	⊙	□~○	△	△~X	□~△
Wear resistance	□	□	○	⊙	□	□	△	□
Heat resistance	□	□	○	□	○	⊙	⊙	○~⊙
Cold resistance	□	□	△	□	△~X	○	△	△~X
Weatherability, Ozon resistance	□	□	□	□~△	□	⊙	⊙	○
Electrical properties	□	□	□	□	△~X	○	○	△
Gas permeability	□	□	□	□	○	□	⊙	○
Flame resistance	□	□	□	□	□	□	□	⊙
Oil resistance	□	□	□	□	⊙	□	□	○
Acid resistance								
Sulfuric acid	□	□	□~△	□~△	□~○	□~○	□~○	□~○
Hydrochloric acid	□	□	□	□	△	○	○	△
Alkali resistance								
Caustic soda	□	□	□~△	□~○	□~○	□~○	□~○	□~○
Ammonium	□	□	□	□	□	○	○	□

Meaning of the signs :

- ◎ Considerably better than NR
- A little better than NR
- Same as NR
- △ A little inferior to NR
- × Considerably inferior to NR

Reference materials used for the above preparation :

- (1) Special BR Issue or others by Synthetic Rubber or Japan Synthetic Rubber
- (2) Data Collection on High-molecular Substances, compiled by the High-molecular Society
- (3) "Friend of Polymer" issued by Taiseisha, Vol. 6, No.4 April 1969
- (4) "Neoprene" of Dupont
- (5) Data of CRC Company
- (6) EPDM catalogs of various companies .
- (7) R&D Report by JSR

Notes:	NR	Natural rubber
	IR	Isoprene rubber
	SBR	Styrene-butadien rubber
	BR	Butadiene rubber
	NBR	Nitrile rubber
	EPDM	Ethylene-propylene-diene methylene linkage
	IIR	Butyl rubber
	CR	Chloroprene rubber

Table AIV-3 Merits and Demerits of Major Rubber Materials

	Advantages	Disadvantages
NR	(1) High tear strength (2) High elasticity (3) Low exotherm	(1) Mingles foreign matters and quality fluctuates
IR (NR-substituting tires, less than 9%)	(1) Heat and aging resistant (2) Low exotherm (3) Simple mastication (4) High crack resistance (5) Good electrical properties	(1) Poor processability (2) Low tensile strength (3) Slow curing speed or not necessary
SBR (tires 60%)	(1) Resistant to aging (2) Resistant to channel cracking (3) Resistant to wear (4) Simple mastication (5) Small curing speed	(1) Requires enforcing agent (small strength) (2) Requires curing accelerator (slow in curing speed) (3) Low in elasticity (4) High internal exotherm (5) High shrinkage fluctuation
BR (tires 20-40%) belt, foot-wears, sponge, horse, rolls	(1) Wear resistant (2) Cold resistant (3) Aging resistant (4) Small internal exotherm (5) Good elasticity	(1) Small strength
NBR (More than 50% are directed to industrial uses) If added the belt and horses - 80%	(1) Oil resistant (2) High mechanical strength (3) Heat resistant (4) Gas non-permeable	(1) Cold resistant (2) Small elasticity

(Continued)

EPDM (automotive parts, belt steel-horse, construction material, electric wires)	(1) Weather resistant (2) Aging resistant (3) Heat resistant (4) Ozone resistant	
IIR (More than 85% for tube, electric wire 7%, other industrial uses)	(1) Weather resistant (2) Aging resistant (3) Heat resistant (4) Gas non-permeable (5) Electric insulation	(1) Slow curing speed (2) Poor processability (3) Low elasticity (4) Low strength
CR (electric wire and industrial uses)	(1) Oil resistant (2) Weather resistant (3) Aging resistant (4) Heat resistant (5) Chemical resistant (6) Ozone resistant (7) Flame resistant	

EPDM: To avoid heat aging, blended items are being used.

(3) Items for industrial use

1) Oscillation resistant rubber

NR has excellent elasticity for absorbance of mechanical oscillation. For the absorbance of intermittent impacts, IIR is much better because of its smaller elasticity.

2) Various packings

There are many varieties of performance depending upon the conditions of use, most requiring heat resistance and oil resistance. Therefore, NBR and CR are being used.

3) Rubber roll

Various type of rubber are being utilized depending on usage, mostly NBR for its oil resistance, and BR for smaller exothermicity.

4) Rubber sheet

Mostly made of NBR.

5) Rubber lining

CR is being used.

(4) Belt

For belt use, BR is used for exhibiting high wear resistance and elasticity, and NBR is being considered for its oil resistance.

(5) Footwears

Mainly SBR is used, also some BR is used taking its wear characteristics and elasticity into account.

(6) Cable and wire insulation

Mostly CR is being used.

ANNEX II. World Rubber Situation (1972)

II-1 Consumption of New Rubber

According to estimates announced in October 1973 by International Rubber Research Institute, world's new rubber consumption was 8,486,000 tons indicating a continuing large increase of 106.5%. By type, it was 5,368,000 tons for synthetic rubber (compared with the previous year, 108.1%), and 3,118,000 tons for natural rubber (likewise 103.8%). As a result, the use ratio of world synthetic rubber has become 63.3% increasing 1% from the previous year. The consumption of synthetic rubber in USA was 2,960,000 tons, which reflected recovery of economic recession and showed 8.6% increase from the previous year, followed by 2nd ranking Japan with 860,000 tons (in comparison with the previous year 106%), West Germany (550,000 tons), England (470,000 tons), France (459,000 tons), Italy (337,000 tons); these 6 countries share more than 66% of world entire consumption, given European countries have not been able to recover from the previous year's economic stagnancy, the consumption growth for France was 103.8%, for Italy 102.7%, England 101.1%, all of them were very low, and the percentage for West Germany was especially low at only 97% indicating lower ratio than previously held.

Table AIV-4 Rubber Consumption in the World

		(Unit : 10 ³ tons)							
		USA	Japan	West Germa- ny	Eng- land	France	Italy	Others	Total
Natural rubber	1968	591	255	170	194	129	100	1,409	2,848
	69	608	268	191	191	150	102	1,475	2,985
	70	568	283	201	188	158	113	1,487	2,998
	71	612	295	198	187	159	121	1,431	3,003
	72	640	310	190	184	164	122	1,508	3,118
Synthetic rubber	1968	1,927	348	253	234	196	160	865	3,983
	69	2,057	426	328	256	226	178	969	4,440
	70	1,949	496	358	274	253	197	1,108	4,635
	71	2,112	516	369	278	270	207	1,213	4,965
	72	2,320	550	360	286	295	215	1,342	5,368
New rubber total	1968	2,518	603	423	428	325	260	2,274	6,831
	69	2,665	694	519	447	376	280	2,444	7,425
	70	2,517	779	559	462	411	311	2,594	7,633
	71	2,724	811	567	465	429	328	2,644	7,968
	72	2,960	860	550	470	459	337	2,850	8,486
Synthetic rubber percentage	1968	76.5	57.7	59.8	54.7	60.3	61.5	38.0	58.3
	69	77.2	61.4	63.2	57.3	60.1	63.6	39.6	59.8
	70	77.4	63.7	64.0	59.3	61.6	63.3	42.7	60.7
	71	77.5	63.6	65.1	59.8	62.9	63.1	45.9	62.3
	72	78.4	64.0	65.5	60.9	64.3	63.8	47.1	63.3

Notes: (1) Figures are based on the monthly statistics of International Rubber Research Society with the estimation for 1972.

(2) Consumptions of synthetic rubbers produced in Communist China and U.S.S.R. are not included.

Table AIV-5 Consumption of Natural Rubber

	United States of America	United Kingdom	France	Federal Republic of Germany	Italy	Netherlands	Total E.E.C.	Other Western Europe	Total Western Europe	Eastern Europe & China	Australia	Brazil	Canada	India	Japan	Others	Total Rest of World	GRAND TOTAL
1962	470,185	166,800	137,096	148,252	80,000	20,512	565,000	112,500	677,500	525,000	31,875	40,721	35,346	51,776	193,000	176,750	531,500	2,207,500
1963	464,565	171,400	137,380	152,262	88,000	19,911	582,500	120,000	702,500	550,000	36,977	36,088	36,609	60,209	193,500	191,500	536,750	2,267,500
1964	489,227	183,800	127,111	155,152	83,000	22,047	597,500	122,500	720,000	560,000	38,977	32,730	40,852	60,076	206,000	223,000	601,500	2,385,000
1965	522,966	186,700	122,515	157,861	87,000	20,800	607,500	135,000	742,500	565,000	36,877	26,554	43,480	64,675	201,500	236,500	609,500	2,445,000
1966	554,435	183,900	125,987	157,604	91,400	22,500	607,500	142,500	750,000	580,000	34,418	30,862	30,862	47,268	216,000	248,500	648,750	2,535,000
1967	496,693	178,500	127,821	141,338	100,000	19,700	595,000	137,500	732,500	605,000	36,863	32,122	46,113	72,516	243,000	257,500	688,000	2,530,000
1968	591,201	194,100	128,810	170,000	100,000	20,566	645,000	150,000	795,000	610,000	38,416	38,155	45,764	84,705	255,000	288,750	751,000	2,765,000
1969	607,872	192,500	149,513	171,241	112,000	20,237	717,500	160,000	877,500	640,000	39,854	35,719	50,616	86,469	268,000	317,000	786,250	2,887,500
1970	686,280	185,200	159,800	188,247	121,000	22,000	720,000	195,000	915,000	640,000	40,125	41,761	52,030	83,235	295,000	380,000	902,000	3,055,000
1971	587,680	187,200	159,203	188,247	121,000	22,000	720,000	195,000	915,000	640,000	40,125	41,761	52,030	83,235	295,000	380,000	902,000	3,055,000
1972 Jan.	56,202	15,400	14,319	13,500	10,000	1,917	57,750	17,250	75,000	52,500	3,045	3,289	4,538	8,298	23,000	32,250	74,500	257,500
Feb.	53,503	11,300	14,544	16,000	10,500	2,057	57,000	17,250	74,250	52,500	2,231	3,649	5,030	8,546	25,000	32,250	76,750	257,500
Mar.	60,067	15,600	15,963	18,536	12,500	2,145	66,250	17,250	83,500	52,500	4,415	3,724	5,342	8,615	27,200	32,250	81,500	277,500
Apr.	52,743	14,400	13,658	15,250	9,250	2,027	57,000	17,250	74,250	52,500	2,855	3,360	5,161	7,880	24,800	33,250	77,250	257,500
May	54,933	15,500	13,650	15,150	11,000	1,795	59,750	17,250	77,000	52,500	4,306	3,416	5,352	7,336	24,800	33,250	78,500	262,500
June	54,087	15,000	15,196	16,764	9,750	1,985	61,250	17,250	78,500	52,500	4,392	3,683	5,406	8,381	26,200	33,250	81,250	267,500
July	41,612	12,000	11,239	1,3750	10,250	1,172	57,000	14,500	65,500	52,500	4,345	3,903	3,897	8,908	26,400	34,250	81,750	240,000
Aug.	56,136	13,200	3,931	12,750	3,750	1,866	36,000	14,500	52,500	52,500	5,420	4,161	4,052	9,017	24,500	34,250	81,250	242,500
Sept.	54,950	15,200	15,269	16,405	9,800	2,177	61,250	17,250	78,500	55,000	2,780	3,702	5,497	9,249	27,600	34,250	83,000	272,500
Oct.	59,406	16,700	13,957	19,000	11,500	2,109	65,750	17,250	83,000	55,000	4,440	3,897	5,084	7,764	28,000	35,250	84,500	282,500
Nov.	53,413	16,400	14,682	18,500	11,250	2,122	65,500	17,250	82,750	55,000	4,010	3,729	5,913	8,068	27,900	35,250	85,000	275,000
Dec.	53,727	13,300	13,748	17,324	9,450	1,828	58,250	17,250	75,500	55,000	3,320	3,766	5,112	9,038	26,600	35,250	83,000	267,500
Year	650,670	174,000	160,154	192,997	118,000	23,200	698,750	201,500	900,250	650,000	45,579	44,219	60,314	101,100	312,000	405,000	968,250	3,170,000
1973 Jan.	59,016	16,100	14,596	16,250*	10,250	1,912*	62,000	17,500	79,500	55,000	1,790	3,677	5,277	9,063	24,200	36,000	80,000	272,500
Feb.	57,738	15,700	13,903	17,500	9,500	2,186	61,750	17,500	79,250	52,560	4,660	4,005	5,677	9,405	26,000	36,000	85,750	275,000
Mar.	64,163	16,600	15,863	18,631	9,750	1,999	66,000	17,500	83,500	55,000	4,620	4,056	5,702	9,909	28,500	36,000	88,750	292,500
Apr.	60,387	15,000	13,931	16,500	8,500	2,023	59,000	17,500	76,500	55,000	4,560	3,886	5,413	9,276	27,100	37,000	87,250	280,000
May	58,255	15,700	14,320	18,250	10,000	2,123	63,250	17,500	80,750	52,500	4,660	4,270	5,164	9,228	27,500	37,000	87,750	280,000
June	55,330	14,100	1,4429	17,683	9,200	1,789	60,250	17,500	77,750	55,000	3,110	4,276	5,206	10,173	29,200	37,000	89,000	277,500
July*	49,756	11,800	12,142	14,750	9,750			14,500		55,000	6,160	4,546	4,182	10,736	28,400	38,000	92,000	262,500
Aug.	57,200	11,000	4,220	14,300	3,750			14,500		55,000	5,720	4,411	3,691	11,608	25,800	38,000	89,250	252,500
Sept.	57,200	14,100	14,759	17,336	9,300			17,500		55,000	2,440	4,116	4,822	11,787	25,000	38,000	90,250	280,000
Oct.	64,429				10,000			17,500		55,000			4,986	9,943				290,000
Nov.																		
Dec.																		
Year																		

* - Monthly allowances of 3,300 metric tons for Germany and of 250 tons for the Netherlands are included to cover consumption outside the traditional rubber industry.
 ** - See footnote ** to Table 4, the figures include estimates for consumption in Belgium, Denmark, the Republic of Ireland and Luxembourg.
 *** - Estimated consumption arrived at by correcting net imports to allow for working stocks at 1.5 months' consumption.
 † - Including allowances for discrepancies in officially reported statistics.
 ‡ - Excluding Eastern Europe and China.

Table AIV-6 Consumption of Synthetic Rubber

	United State of America	United Kingdom	France	Federal Republic of Germany	Italy	Nether- lands	Total EEC **	Other Western Europe ***	Total Western Europe	Eastern Europe & China P	Aus- tralia	Brazil	Canada	India	Japan	Others **	Total Rest of World †	GRAND TOTAL ‡
1962	1,276,090	134,900	110,055	131,404	73,000	13,799	485,000	75,000	560,000	575,000	25,829	29,217	74,186	10,409	106,010	90,000	335,750	2,782,500
1963	1,277,756	145,800	126,332	145,172	92,000	14,795	550,000	90,000	640,000	625,000	33,289	34,372	82,087	11,624	127,520	105,750	397,750	3,070,000
1964	1,474,806	168,400	147,410	177,096	97,000	16,625	640,000	70,000	710,000	700,000	35,821	40,906	92,338	14,062	162,060	134,000	499,250	3,440,000
1965	1,565,928	182,700	154,448	208,523	113,000	20,557	715,000	130,000	845,000	775,000	37,559	37,859	108,870	20,414	175,500	173,000	542,500	3,732,500
1966	1,682,792	199,000	175,098	212,185	132,000	23,800	777,500	157,500	935,000	850,000	36,567	51,408	108,870	21,947	222,000	183,750	624,500	4,127,500
1967	1,654,387	205,500	188,300	200,600	155,000	24,251	810,000	165,000	975,000	900,000	39,570	57,024	110,150	25,247	273,000	189,000	694,250	4,262,500
1968	1,926,629	234,000	196,004	253,000	160,000	28,237	915,000	170,000	1,085,000	1,000,000	44,706	70,542	106,175	24,516	348,000	226,750	820,750	4,837,500
1969	2,056,542	256,000	230,822	327,973	178,000	28,247	1,072,500	222,000	1,294,500	1,200,000	42,572	67,110	123,088	30,761	426,000	259,000	958,750	5,335,000
1970	1,948,628	273,600	260,921	358,087	197,000	45,800	1,200,000	252,500	1,452,500	1,100,000	40,572	69,154	138,968	31,810	496,000	309,500	1,103,750	5,605,000
1971	2,118,643	277,800	283,473	369,197	206,500	54,900	1,257,500	275,000	1,532,500	1,175,000	60,143	97,483	138,292	36,872	525,000	317,250	1,194,750	6,082,500
1972 Jan.	185,117	22,600	26,182	25,000	18,000	4,392	103,250	27,250	130,500	100,000	2,253	8,103	12,887	3,197	41,400	26,250	94,000	510,000
Feb.	189,709	17,300	26,326	30,000	19,000	4,683	104,250	27,250	131,500	100,000	5,624	8,725	14,915	3,268	45,200	26,250	104,000	525,000
Mar.	204,621	23,900	27,747	35,097q	21,000q	5,017	119,750	27,250	147,000	105,000	5,679	9,487	15,190	3,303	50,600	26,260	110,500	567,500
Apr.	192,793	21,800	24,580	29,750	16,750	4,553	104,500	27,250	131,750	105,000	4,527	8,669	14,589	2,990	45,300	26,750	102,750	532,500
May	200,120	24,100	25,250	29,600	19,750	5,961	109,750	27,250	137,000	105,000	4,577	9,538	14,739	2,641	45,300	26,750	103,500	545,000
Jun.	200,437q	23,400	27,073	32,637q	17,704q	5,133	113,500	27,250	140,750	105,000	5,144	9,237	16,069	3,293	48,700	26,750	109,250	555,000
Jul.	154,533	18,000	20,080	26,500	20,250	3,622	95,500	22,500	118,000	105,000	4,965	9,917	11,267	3,258	50,600	27,250	107,500	485,000
Aug.	154,966	21,200	7,329	33,750	7,500	5,231	72,000	22,500	94,500	105,000	5,260	10,358	11,267	3,411	50,000	27,250	105,500	500,000
Sept.	198,982q	25,200	28,231	30,592q	20,850q	5,058	116,250	27,250	143,500	105,000	4,950	9,692	14,989	3,211	50,000	27,250	113,000	560,000
Oct.	211,560	26,400	26,523	34,500	21,500	5,263	121,250	27,250	148,500	105,000	4,230	10,249	15,029	2,734	53,900	27,750	113,750	580,000
Nov.	197,078	26,400	25,559	33,750	20,750	5,514	119,000	27,250	146,250	105,000	4,930	10,358	16,548	2,843	53,600	27,750	116,000	580,000
Dec.	196,350	22,300	28,860	31,265q	17,750q	4,551	107,750	27,250	135,000	105,000	5,010	9,623	15,021	3,001	53,500	28,750	115,000	552,500
Year	2,328,466	272,600	289,847	362,441	220,000	56,900	1,286,250	317,500	1,603,750	1,250,000	57,669	114,290	172,815	37,190	586,000	335,000	1,304,750	6,487,500
1873 Jan.	289,823	25,100	25,761	30,000*	20,000	4,517*	113,500	31,500	145,000	110,000	3,030	9,805	14,834	1,900	53,000	31,000	113,500	577,500
Feb.	231,069	24,400	24,960	32,750	19,250	4,915	114,250	31,500	145,750	110,000	4,880	10,471	16,136	1,926	56,600	31,000	121,000	560,000
Mar.	224,185	26,100	27,770	35,102q	20,550	5,059	122,500	31,500	154,000	110,000	5,290	11,661	16,642	1,733	60,400	31,000	126,750	615,000
Apr.	202,223	22,700	23,845	30,500	17,500	5,201	107,750	31,500	139,250	110,000	4,570	10,615	16,054	1,885	55,300	32,000	120,500	572,500
May	200,890	25,400	26,282	33,250	20,000	5,312	118,250	31,500	149,750	110,000	5,670	12,198	16,396	1,999	56,700	32,000	125,000	585,000
Jun.	199,210	22,300	26,215	32,002q	18,200q	4,674	111,250	31,500	142,750	110,000	6,180	12,020	16,651	2,164	60,500	32,000	129,750	582,500
Jul.	183,226	20,800	22,594	27,750	21,705	27,000	110,000	27,000	137,000	110,000	7,330	12,552	11,952	1,793	60,700	33,000	127,250	550,000
Aug.	212,845	21,700	8,289	28,000	9,000	27,000	110,000	6,400	116,400	110,000	6,400	13,692	11,795	1,512	61,800	33,000	121,000	547,500
Sept.	212,431	22,000	27,535	33,180q	21,750q	31,500	110,000	5,520	115,520	110,000	5,520	12,780	15,395	1,940	61,500	33,000	130,250	602,500
Oct.	235,415																	
Nov.																		
Dec.																		
Year																		

* - Monthly allowances of 8,200 metric tons for Germany and of 2,000 tons for the Netherlands are included to cover consumption outside the traditional "EEC" area. See footnote ** to Table 5.
 ** - Estimated consumption arrived at by correcting net imports - where appropriate adjusted for local supply - to allow for working stocks of one month's consumption in "Other Western Europe" and 1.5 months' consumption in "Others".
 † - Excluding Eastern Europe and China.
 ‡ - Including allowances for apparent discrepancies in officially reported statistics.

Table AIV-7 Consumption of Natural and Synthetic Rubber

	United States of America	United Kingdom	France	Federal Republic of Germany	Italy	Nether-lands	Total E. C. C.	Other Western Europe	Total Western Europe	Aus-ustralia	Canada	India	Japan	Others	Total Rest of World	GRAND TOTAL	
1962	1,746,275	301,700	237,151	279,656	153,000	34,311	1,050,000	187,500	1,237,500	59,704	109,532	62,185	299,010	266,750	867,250	4,590,000	
1963	1,792,321	317,200	253,712	297,438	180,000	40,705	1,132,500	210,000	1,342,500	70,266	70,460	71,933	333,020	297,000	954,500	5,287,500	
1964	1,864,033	322,200	278,261	322,184	200,000	41,357	1,237,500	232,500	1,470,000	74,778	73,636	74,138	368,060	377,000	1,100,750	5,825,000	
1965	2,071,728	332,900	278,261	322,184	200,000	41,357	1,317,500	265,000	1,582,500	74,406	84,413	85,089	377,000	410,000	1,152,000	6,177,500	
1966	2,247,227	382,900	303,085	369,789	223,400	46,350	1,385,000	300,000	1,685,000	70,985	82,270	86,640	438,000	432,250	1,268,250	6,662,500	
1967	2,511,080	384,000	326,122	341,938	255,000	43,951	1,405,000	302,500	1,707,500	76,433	89,157	97,763	516,000	446,500	1,382,250	7,792,500	
1968	2,517,810	428,100	324,814	423,000	260,000	48,801	1,560,000	342,500	1,902,500	83,122	108,698	109,722	603,000	516,500	1,571,000	8,222,500	
1969	2,664,414	447,400	380,333	519,214	280,000	48,604	1,760,000	385,000	2,145,000	82,566	106,192	117,453	594,000	576,500	1,646,250	8,567,500	
1970	2,516,918	461,800	419,150	559,812	310,000	67,800	1,917,500	430,000	2,347,500	85,247	124,993	128,750	620,000	620,000	1,846,250	9,137,500	
1971	2,725,723	465,000	442,676	567,444	327,500	76,900	1,977,500	470,000	2,447,500	100,266	139,249	139,797	820,000	897,250	2,096,750	9,137,500	
1972	241,319	38,000	40,501	38,500	28,000	6,309	161,000	44,500	205,500	5,298	11,392	17,425	64,400	58,500	168,500	767,500	
Jan.	243,212	28,600	40,501	38,500	28,000	6,309	161,000	44,500	205,500	5,298	11,392	17,425	64,400	58,500	168,500	767,500	
Feb.	264,689	39,500	43,710	37,630q	32,500q	7,162	186,000	44,500	230,500	7,875	12,374	19,945	70,200	58,500	180,750	782,500	
Mar.	245,515	36,200	38,138	45,000	26,000	6,580	161,500	44,500	206,000	7,882	12,029	19,750	70,100	60,000	180,000	790,000	
Apr.	235,053	39,600	38,505	44,750	30,750	5,656	169,500	44,500	214,000	8,883	12,954	20,091	70,100	60,000	182,000	807,500	
May	234,524q	38,400	42,269	49,401q	27,450q	7,140	174,250	44,500	218,750	9,536	12,920	21,475	74,900	60,000	190,500	822,500	
Jun.	196,045	30,500	31,319	40,230	30,500	4,794	146,500	37,000	183,500	9,310	13,820	15,164	71,000	61,500	189,250	725,000	
Jul.	231,102	34,400	31,260	36,500	11,250	7,097	110,000	37,000	147,000	11,180	14,793	13,338	71,000	61,500	182,250	742,500	
Aug.	253,932q	40,400	43,500	46,997q	29,850q	7,235	177,500	44,500	222,000	7,710	13,394	20,486	60,600	61,500	196,000	832,500	
Sept.	272,966	43,100	46,482	51,500	33,000	7,372	187,000	44,500	231,500	8,670	14,146	20,113	81,900	63,000	198,250	862,500	
Oct.	250,491	42,800	40,241	52,239	32,000	7,936	184,500	44,500	229,000	8,940	14,087	22,481	81,500	63,000	201,000	840,000	
Nov.	250,271	35,800	38,606	48,657q	27,200q	6,379	166,000	44,500	210,500	8,150	13,389	20,133	80,100	64,000	198,000	820,000	
Dec.	2,979,145	446,600	450,001	555,438	338,000	80,100	1,985,000	519,000	2,504,000	103,248	156,509	138,200	900,000	740,000	2,273,000	9,657,500	
1973	268,839	41,200	40,357	46,250*	30,250	6,423*	175,500	49,000	224,500	4,820	13,482	20,111	10,963	77,200	67,000	193,500	850,000
Jan.	260,747	40,100	38,863	50,250	28,750	7,058	170,000	49,000	219,000	5,640	14,482	21,341	82,600	67,000	206,750	855,000	
Feb.	288,348	42,700	43,642	51,733q	30,300q	7,058	188,500	49,000	237,500	9,910	15,717	22,344	88,900	67,000	215,500	907,500	
Mar.	262,610	37,200	37,776	47,000	26,000	7,224	166,750	49,000	215,750	9,130	14,501	21,467	82,400	69,000	207,750	852,500	
Apr.	259,145	41,100	40,502	51,500	30,000	7,435	181,500	49,000	230,500	10,330	16,468	21,560	84,200	69,000	212,750	865,000	
May	254,540	36,400	40,644	49,685q	27,400q	6,463	171,500	49,000	220,500	9,230	16,296	22,057	89,700	69,000	216,750	860,000	
Jun.	232,982	32,700	34,736	42,500	31,500	41,500	165,000	41,500	206,500	13,490	17,098	16,134	89,100	71,000	219,250	812,500	
Jul.	270,145	33,500	32,519	42,500	32,750	41,500	162,500	41,500	204,000	12,120	18,103	15,486	80,400	71,000	210,250	800,000	
Aug.	269,631	36,100	42,394	50,518q	31,050q	49,000	165,000	49,000	214,000	7,960	16,896	20,217	90,300	71,000	220,500	882,500	
Sept.	299,844		33,750			49,000	165,000	49,000	214,000		22,408	11,982	73,000		910,000		
Oct.																	
Nov.																	
Dec.																	
Year																	

Notes: * - See footnotes in Tables 6 and 26.
 ** - See footnotes in Table 6.
 † - Including statistics for the People's Republic of China.
 ‡ - Including allowances for apparent discrepancies in officially reported statistics.

The United States has the highest synthetic rubber usage rate at 78.4%. Japan and all European countries are showing only fractional growth, and are averaging approximately 64% (Table AIV-4).

II-2 Supply of New Rubber

World new rubber supply capability is 8,439,000 tons (excluding stock and supplies from East European countries), and according to the estimation made for 1972 by the International Rubber Research Institute, there is a 105.3% growth rate compared with the previous year, of which synthetic rubber was 5,345,000 tons (106.7% of the previous year) and natural rubber 3,094,000 tons (102.8%).

(1) Major countries' natural rubber production

Malaysia 1,330,000 tons, Indonesia 844,000 tons, Thailand 320,000 tons - these 3 countries produce more than 80% of the world natural rubber. However, production growth in these 3 countries is least affected, only 1%, by unusual weather conditions. On the contrary, various African countries indicated production increases, especially noteworthy was the advance of Liberia to 6th, next to India.

Viet-Nam used to produce about 70,000 tons of rubber but in view of the long-lasting war there, it dropped to about 20,000 tons.

(2) Production of synthetic rubber by country

The U.S.A. produces 2,500,000 tons which is about 47% of total world production, and has nearly a 10% increase over the previous year. Japan follows with 780,000 tons, then France 330,000 tons, West Germany 300,000 tons, England 295,000 tons, and Canada 205,000 tons. In countries other than the United States, England showed 6% increase, all others indicated only a small increase of 2 - 3%, and West Germany went down from the previous year.

New rubber supply position in the world during 1972 is given in Table AIV-8.

Table AIV-8 Supply and Demand Position of New Rubber in the World

	(Unit: 10 ³ tons)		
	Natural Rubber	Synthetic Rubber	Total
Production	3,095	5,345	8,440
Shipment from the Stock & Supply from Eastern Hemisphere	50	45	95
Total Supplies	3,145	5,390	8,535
Consumptions	3,120	5,365	8,485
Increase or Decrease of the Stock	+25	+25	+50

Table AIV-9 Summary of Rubber Production in the World

Natural Rubber								
	Malaysia	Indonesia	Thailand	Sri Lanka	India	Liberia	Others	Total
1968	1,100	752	259	149	69		304	2,633
1969	1,263	790	282	151	80		314	2,855
1970	1,269	780	287	159	90		313	2,898
1971	1,324	834	316	141	99		289	3,003
1972	1,330	844	320	155	110	96	29	3,094

Synthetic Rubber								
	U.S.A.	Japan	France	W. Germany	England	Canada	Others	Total
1968	2,165	381	223	238	237	197	612	4,053
1969	2,286	526	275	292	273	199	724	4,575
1970	2,232	698	316	302	306	205	809	4,868
1971	2,277	759	323	306	277	197	869	5,008
1972	2,500	780	330	300	295	205	935	5,545

Table AIV-10 Production of Natural Rubber

Year	Malaysia		Grand	Indonesia		Thailand	Sri Lanka	Viet-Nam	Korea Repub-lic	India	Africa	Brazil	Others	Total Estates Holdings	Total
	Malaysia			Indonesia											
	West Malaysia	East Malaysia		Sumatra	Smallh.										
1962	445,284	281,046	726,330	309,356	417,974	185,363	104,646	71,219	41,552	31,357	124,250	21,742	32,710	892.5	1,178.0
1963	465,659	289,438	755,097	310,914	444,183	195,415	105,924	71,219	41,552	31,357	124,250	21,742	32,710	901.5	1,152.0
1964	484,493	319,438	803,931	322,214	481,717	221,482	111,562	74,423	45,833	44,248	161,750	26,322	29,500	1,067.5	1,283.0
1965	499,821	331,208	831,029	319,536	511,493	216,466	118,311	60,961	48,917	49,387	159,250	29,351	31,750	1,067.5	1,285.0
1966	523,101	332,624	855,725	308,813	546,912	207,535	131,015	68,841	53,195	53,195	176,500	24,347	31,000	2,155.0	1,305.0
1967	534,216	403,941	938,157	300,562	637,595	216,119	143,204	40,631	53,663	63,339	163,000	21,494	31,250	1,102.5	1,420.0
1968	572,076	479,233	1,051,310	287,569	763,741	259,221	146,719	29,696	51,332	68,845	169,000	22,958	40,750	1,145.0	1,540.0
1969	602,354	596,484	1,198,838	222,693	976,145	283,381	150,834	26,151	51,836	79,951	181,750	23,950	43,500	1,295.0	1,790.0
1970	620,291	584,723	1,205,014	238,495	966,519	287,163	159,158	28,438	12,763	69,805	213,000	24,976	44,500	1,227.5	1,875.0
1971	661,373	608,863	1,270,236	240,000	1,030,236	316,323	141,409	34,533	1,147	98,884	201,250	24,231	50,500	1,245.0	1,832.5
1972 Jan.	77,128	69,077	146,205	4,580	150,785	19,829	17,689	1,903	500	10,669	17,750	2,328	4,500	132.5	165.0
Feb.	49,248	48,659	97,907	2,959	100,876	18,565	10,379	1,061	500	4,321	19,000	1,567	4,500	85.0	145.0
Mar.	44,268	36,911	81,179	4,316	85,495	17,091	10,218	519	500	7,091	14,000	2,506	4,750	87.5	140.0
Apr.	39,229	31,216	70,445	4,068	66,377	16,693	10,211	976	1,250	7,556	14,000	2,111	4,000	77.5	142.5
May	51,627	43,271	94,898	4,068	90,830	18,076	12,274	1,771	1,250	6,497	13,250	2,106	4,750	97.5	145.0
Jun.	52,943	47,973	100,916	2,936	103,852	20,519	9,507	1,609	1,500	8,608	15,000	1,912	4,500	100.0	142.5
Jul.	60,856	55,276	116,132	3,598	112,534	20,223	9,058	1,666	1,500	7,106	11,500	2,039	4,750	107.5	157.5
Aug.	61,844	52,783	114,627	4,021	110,606	18,406	8,416	1,868	1,500	6,383	11,750	2,463	4,750	107.5	147.5
Sept.	57,479	48,933	106,412	3,451	102,961	17,000	13,341	1,430	1,500	9,366	13,750	1,966	4,750	110.0	147.5
Oct.	65,985	56,283	122,268	4,377	117,891	20,000	13,449	1,640	1,750	11,028	18,750	2,288	4,500	107.5	147.5
Nov.	54,946	48,926	103,872	3,378	100,494	17,250	11,616	1,853	1,750	12,421	18,750	2,108	4,500	107.5	147.5
Dec.	65,808	60,086	125,894	4,378	121,516	18,425	12,483	2,367	1,812	14,091	17,750	1,908	4,500	107.5	147.5
Year	679,871	598,813	1,278,684	46,212	1,324,896	818,668	336,919	140,371	19,959	15,317	206,000	25,818	54,500	3,112.5	3,112.5
1971 Jan.	69,164	79,564	148,728	6,087	154,815	72,500	34,378	16,682	1,667	12,314	18,250	2,580	5,000	5,000	325.0
Feb.	50,528	56,116	106,644	3,768	110,412	67,500	36,942	8,731	1,888	4,918	16,750	1,913	4,250	4,250	270.0
Mar.	43,552	55,702	99,254	5,710	104,964	72,500	35,313	10,330	809	7,876	-	2,043	5,000	5,000	260.0
Apr.	37,375	44,351	81,726	4,345	86,071	72,500	35,361	14,112	1,104	8,507	-	2,153	4,750	4,750	222.5
May	50,692	57,874	108,566	5,424	113,990	67,500	25,268	9,382	1,680	9,485	18,250	1,910	4,500	4,500	352.5
Jun.	56,221	64,516	120,737	6,749	127,486	67,500	31,216	6,750	1,948	9,652	15,750	1,823	4,750	4,750	285.0
Jul.	65,009	72,379	137,388	7,553	144,941	72,500	31,223	11,226	1,841	10,000	17,500	2,147	5,000	5,000	390.0
Aug.	62,986	69,323	132,309	6,050	141,965	72,500	25,908	14,801	1,869	10,000	17,750	1,683	4,500	4,500	286.0
Sept.	64,926	67,487	132,413	6,347	138,760	72,500	28,425	14,801	1,860	11,577	17,750	2,097	4,750	4,750	290.0
Oct.	60,119	71,817	131,936	5,950	137,886	72,500	26,432	12,185	2,366	12,185	-	5,000	5,000	305.0	
Nov.															
Dec.															

* Has been taken as equivalent to net exports - see Table 3.

** See footnote to Table 1.

*** Equivalent to net exports plus local consumption - see Tables 3(a) and 6(a).

† See footnote to Table 1.

‡ See Table 2 (a).

§ Including allowances for apparent discrepancies in officially reported statistics.

continued

	Spain	Czechoslovakia	German Democratic Republic	Poland	Rumania	Other Eastern Europe	Japan	China	Australia	Brazil	India	Republic of South Africa	Argentina	Mexico	TOTAL
1962	-	-	90,480	33,251	-	420,000	69,913	15,000	13,868	15,990	-	-	-	-	2,832,500
1963	-	-	89,510	35,964	5,906	465,000	102,574	20,000	17,406	29,959	6,958	-	-	-	3,105,000
1964	-	20,000	93,693	39,964	19,373	500,000	121,960	25,000	18,460	32,496	11,801	6,233	-	-	3,522,500
1965	-	30,000	94,780	39,221	30,820	540,000	161,320	25,000	21,123	38,691	15,738	15,653	3,491	-	3,790,000
1966	1,386	30,000	101,380	37,478	35,474	615,000	232,695	25,000	20,075	54,215	15,604	18,677	10,471	780	4,207,500
1967	11,499	32,000	109,502	40,065	51,275	635,000	280,590	25,000	26,126	51,540	21,807	23,817	17,116	19,774	4,335,000
1968	26,567	35,000	101,643	40,795	53,962	680,000	380,670	25,000	30,481	58,856	25,190	25,180	22,785	33,506	4,912,500
1969	34,552	40,000	113,879	48,147	55,207	725,000	526,480	25,000	33,042	61,671	24,614	24,059	38,000	36,000	5,495,000
1970	38,606	50,000	117,971	61,661	61,234	790,000	697,530	25,000	33,000	75,459	30,337	28,575	39,000	40,000	5,855,000
1971	45,360	51,600	129,363	66,169	71,001	855,000	779,770	25,000	43,418	78,234	33,007	29,703	37,500	45,000	6,082,500
1972 Jan.	5,750	4,250	11,000	6,372	6,000	72,500	61,590	2,000	2,439	6,578	2,446	2,800	3,500	3,250	532,500
Feb.	5,500	4,250	11,000	5,964	6,000	72,500	63,960	2,250	3,456	7,431	3,051	2,497	3,500	3,500	519,000
Mar.	5,750	4,250	11,000	7,526	6,000	72,500	64,340	2,000	3,455	6,056	3,500	1,615	3,500	3,250	552,500
Apr.	5,750	4,250	11,000	7,022	6,000	72,500	66,720	2,000	3,457	7,756	3,031	1,887	3,500	3,250	547,500
May	5,500	4,250	11,000	7,216	6,000	75,000	72,650	2,250	3,456	9,257	2,694	3,161	3,750	3,500	565,000
Jun.	5,750	4,250	11,000	6,516	6,000	80,000	69,410	2,000	3,456	6,580	2,169	3,670	3,750	3,250	540,000
Jul.	6,000	4,250	11,000	6,738	6,000	80,000	67,070	2,000	3,658	8,770	2,372	1,576	3,750	3,250	507,500
Aug.	6,000	4,250	11,000	6,644	6,250	80,000	72,030	2,250	3,658	7,613	1,342	1,796	3,750	3,500	522,500
Sept.	6,000	4,250	11,000	6,023	6,250	80,000	58,100	2,000	3,658	8,286	2,709	3,682	3,750	3,250	532,500
Oct.	6,000	4,500	11,250	5,761	6,250	80,000	70,080	2,000	3,658	8,787	1,941	2,498	3,750	3,250	570,000
Nov.	6,000	4,250	11,250	5,859	6,250	80,000	71,550	2,250	3,658	7,254	1,392	1,808	3,750	3,500	565,000
Dec.	6,000	4,500	11,250	6,414	6,250	80,000	81,860	2,000	3,658	10,213	1,194	3,051	3,750	3,250	575,000
Year	70,000	51,500	132,743	78,055	73,279	925,000	819,360	25,000	41,667	94,581	27,841	30,041	44,000	40,000	6,525,000
1973 Jan.	6,250	4,500	11,250	7,427	6,250	80,000	81,250	2,000	2,140	7,061	1,34	2,221	4,000	3,750	597,500
Feb.	6,250	4,250	11,250	6,660	6,250	82,500	83,110	2,250	3,850	5,470	1,447	1,738	3,750	3,750	585,000
Mar.	6,250	4,500	11,250	7,642	6,250	80,000	83,140	2,000	3,850	13,242	1,407	3,342	4,000	3,750	615,000
Apr.	6,250	4,500	11,250	8,107	6,250	80,000	88,000	2,000	3,850	9,431	3,170	2,395	4,000	3,750	625,000
May	6,250	4,250	11,250	8,267	6,250	82,500	86,730	2,250	3,850	8,268	3,065	1,415	3,750	3,750	632,500
Jun.	6,250	4,500	11,250	8,103	6,250	80,000	89,400	2,000	3,850	9,574	675	3,324	4,000	3,750	595,000
Jul.	6,250	4,500	11,250	7,509	6,250	82,500	67,940	2,000	3,850	10,761	748	1,856	4,000	3,750	562,500
Aug.	6,250	4,250	11,250	8,116	6,250	82,500	75,860	2,250	3,850	13,255	1,349	1,837	3,750	3,750	615,000
Sept.	6,250	4,500	11,250	7,809	6,250	82,500	80,750	2,000	3,850	11,450	2,647	3,497	4,000	3,750	612,500
Oct.	6,250	4,500	11,250		6,250	82,500	79,020	2,000			3,175		4,000	3,750	645,000
Nov.															
Dec.															
Year															

ANNEX III Situation on the Japanese Industry

	S B R		C R		N B R		I R		B R		J R		EPDM		Others		Grand total					
	Oil		Solid		Solid		Solid		Solid		Solid		Solid		Solid		Latex					
	Non-oil	High	Latex	Styrene	Latex	Styrene	Latex	Styrene	Latex	Styrene	Latex	Styrene	Latex	Styrene	Latex	Styrene	Latex	Total	%			
Domestic																						
Tires and tubes of motor car	72,869	160,586	5,176	165	34,644	58,227	12,869	4,971										344,331	5,716	350,047	35.6	
Footwear	18,661	6,863	11,286		1,996	4,491	1,119									96		44,512		44,512	4.5	
Industrial use	18,906	19,643	1,232	781	21,196	111	8,643	223	2,972	6,157	9,197	8,724	1,517					98,192	1,115	99,307	10.1	
Others	29,397	8,238	1,693	6,045	3,521	377	11,100	81	4,329	14,625	12,163	530	470	4,674				90,210	7,033	97,243	9.9	
Sub-total	139,833	195,330	14,211	12,542	24,862	488	21,744	304	41,945	83,500	35,348	530	14,165	6,287				577,245	13,864	591,109	60.1	
Other application																						
Wire & cable		327			3,402			810			89		698					5,326		5,326	0.5	
Paper processing	14		39,282	844	360	729												858	45,585	46,443	4.7	
Adhesives	1,047		592	5,578	8	68	117	150	18		104	311						14	6,965	1,042	8,007	0.8
Textile processing			17,363		103	957												907		19,330	19,330	2.0
Building material			1,740		10		1,604						2,372					22	3,981	1,772	5,753	0.6
Paint & pigment			696			45												1		742	742	0.1
For plastics	1,270	37	11,428		325	412	19,953						860					590	2,492	32,383	34,875	3.5
(For house consumption)	(104)	(37)	(2,126)		(403)		(4,686)						(860)					(590)	(1,001)	(7,807)	(8,808)	(0.9)
Others	2		144		138		186		44	146	388	98	119	2,330				9	3,069	535	3,604	0.4
Sub-total	2,333	364	71,245	9,824	619	393	2,260	2,755	62	20,099	581	409	4,049	2,330	6,757	22,691	101,389	124,080	124,080	12.6		
Total	142,166	195,694	14,211	83,787	34,706	1,107	22,137	2,564	44,700	83,562	20,089	35,929	939	18,214	8,617	6,757	599,936	115,253	715,189	72.7		
Export	57,771	86,790	8,449	5,342	25,788	9	4,515	3,540	67,632	7,734	638	72	521	262,929	5,872	268,801	27.3					
Grand total	199,937	282,484	22,660	89,129	60,494	1,115	26,652	2,564	48,240	151,194	20,099	43,663	939	18,852	8,689	7,278	862,865	121,125	983,990	100.0		
%	20.3	28.7	2.3	9.1	6.2	0.1	2.7	0.3	4.9	15.4	2.0	4.4	0.1	1.9	0.9	0.7	87.7	12.3	100.0			

ANNEX IV Prices of Natural and Synthetic Rubber

Table AIV-12 Trend of Natural and Synthetic Rubber Price

	NATURAL RUBBER										S B B (Market Price)																
	Singapore					London					New York					1 7 1 2					1 5 0 0						
	W/ty	Max.	Min.	Max.	Min.	Pence/lb	Max.	Min.	Max.	Min.	U.S./lb	Max.	Min.	Max.	Min.	U.S.A. Belgium	France	Germany	Holland	Italy	United	U.S.A. Belgium	France	Germany	Holland	Italy	United
Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	DM/Lb	Francs/kg	DM/kg	Fl/kg	Lira/kg	£/100kg	DM/Lb	Francs/kg	DM/kg	Fl/kg	Lira/kg	£/100kg	
1965	197.2	165.3	75	3/8	64	1/2	25	1/8	17	1/16	28.75	23.25	17.75	18.25	1.68	1.59	1.46	210	14.01	21.00	22.80	2.17	1.93	1.80	272	17.23	
1966	185.0	160.9	71	3/8	58	3/4	21	13/16	17	15/16	26.25	22.00	17.75	18.25	1.59	1.49	1.39	210	14.01	21.00	22.80	2.07	1.92	1.74	272	17.23	
1967	163.3	119.9	60	1/8	46	3/4	20	1/4	14	9/16	22.40	17.85	17.75	18.25	1.59	1.49	1.39	210	11.09	21.00	22.80	2.07	1.92	1.74	272	15.85	
1968	162.4	119.6	59	7/8	43	1/2	21	7/8	16	1/16	24.00	18.40	17.75	15.00	1.51	1.28	1.25	195	13.09	21.00	21.00	1.93	1.60	1.60	250	15.85	
1969	220.0	151.2	85	3/4	57	1/8	29	3/8	20	15/16	31.55	22.20	17.75	16.80	1.57	1.26	1.21	203	13.55	21.00	21.00	2.00	1.55	1.52	265	16.54	
1970	188.0	129.0	72	-	46	7/8	24	15/16	18	1/8	27.0	18 3/4	17.75	16.80	1.65	1.24	1.21	213	13.57	21.00	21.00	2.08	1.55	1.52	279	16.56	
1971	147.9	93.1	117.75	85.00	18.05	13.45	20	1/4	17	3/8	17.75	15.30	17.75	15.30	1.68	1.07	1.11	213	14.25	21.00	19.25	2.10	1.35	1.39	279	17.45	
1972	137.4	92.6	116.75	81.75	21.10	12.05	22	1/4	17	1/8	17.75	15.30	17.75	15.30	1.68	1.07	1.11	206	15.30	21.00	19.25	2.10	1.35	1.39	255	18.75	
1973 Jan.	158.6	130.7	130.05	120.0	22.40	21.00	23	1/4	22	3/4	17.75	15.30	17.75	15.30	1.68	1.07	1.11	206	15.30	21.00	19.25	2.10	1.35	1.39	255	18.75	
Feb.	164.3	139.1	132.50	125.50	23.80	22.25	26	1/8	23	3/4	17.75	15.30	17.75	15.30	1.68	1.07	1.11	198	15.30	21.00	19.25	2.10	1.35	1.39	245	18.75	
Mar.	155.1	139.6	144.25	131.50	28.10	23.75	30	1/4	26	1/2	17.75	15.30	17.75	15.30	1.68	1.07	1.11	198	15.30	21.00	19.25	2.10	1.35	1.39	245	18.75	
Apr.	156.9	120.0	149.50	129.50	26.90	22.50	31	1/2	31	-	17.75	15.30	17.75	15.30	1.68	1.07	1.11	198	15.30	21.00	19.25	2.10	1.35	1.39	245	18.75	
May	161.8	141.3	149.50	131.50	26.00	21.70	34	1/4	31	-	17.75	15.30	17.75	15.30	1.68	1.07	1.11	198	15.30	21.00	19.25	2.10	1.35	1.39	245	18.75	
Jun.	204.9	164.2	188.00	152.25	33.00	25.90	42	1/4	35	1/4	17.75	15.30	17.75	15.30	1.68	1.07	1.11	198	15.30	21.00	19.25	2.10	1.35	1.39	245	18.75	
Jul.	251.6	196.6	219.30	173.50	42.00	31.20	49	1/2	40	-	17.75	15.30	17.75	15.30	1.68	1.07	1.11	198	15.30	21.00	19.25	2.10	1.35	1.39	245	18.75	
Aug.																											
Sep.																											
Oct.																											
Nov.																											
Dec.																											

Table AIV-13 Trend of Exfactory Price of SBR in Japan

(Unit: ¥/Kg)

		High Styrene	Solid Non-Oil	Oil	Latex
1969		-	-	-	-
1970		198.1	153.4	123.5	216.1
1971		195.8	148.4	121.5	214.4
1972		194.0	141.0	115.2	209.1
1973	Jan.	194.5	142.7	114.4	212.3
	Feb.	192.9	141.9	114.9	209.7
	Mar.	193.4	141.5	113.6	209.6
	Apr.	197.2	144.8	116.7	210.1
	May	197.1	144.7	116.9	212.3
	Jun.	196.2	144.8	115.8	210.9
	Jul.	198.8	146.1	118.1	209.6
	Aug.	198.5	146.8	118.3	211.7
	Sep.	198.5	147.6	119.0	212.6
	Oct.	217.1	156.2	124.4	214.3
	Nov.	254.0	169.3	135.6	226.9
	Dec.	283.9	201.0	166.7	234.0

