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DP/ID/SER.A/230
23 October 1978
English

CONSULTANCIES ON DEVELOPMENT OF

CONDOM PRODUCTION

PF/SRV/78/001

SOCIALIST REPUBLIC OF VIET NAM

7 DEC 1980

Technical report: Establishing a latex contraceptives manufacturing plant

Prepared for the Socialist Republic of Viet Nam
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Itsuo Koyama, Teruo Kashiwagi,
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United Nations Industrial Development Organizaion
Vienna

id.78-7433

Explanatory notes

References to dollars ($) are to United States dollars.

A slash between dates (1974/75) indicates a crop year or financial year.

Use of a hyphen between dates (1972-1975) indicates the full period involved, including the beginning and end years.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions, except in tables.

The following forms have been used in tables:

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

A minus sign before a figure (-2) denotes a deficit or decrease, except as indicated.

Parentheses around a figure indicate that it does not contribute directly to the total of the row or column in which it appears.

Totals may not add precisely because of rounding.

The following abbreviations of technical terms and organizations have been used in this report:

IUD	intra-uterine device
SIDA	Swedish International Development Authority

ABSTRACT

The Ministry of Health in the Socialist Republic of Viet Nam began family planning on a national basis in 1976, and decided to establish a latex rubber contraceptives manufacturing factory utilizing local latex. The United Nations Industrial Development Organization (UNIDO), as executing agency for the project "Consultancies on development of condom production" (PF/SRV/73/001), provided three experts to undertake a study of the feasibility of the project, taking into account the Ministry's demand that the condom quality must be equal to the Japanese product and that the raw latex must be of local origin.

There is a special need for high quality latex for the manufacture of condoms in tropical zones. The consultants recommended that a laboratory should first be established to study refining technology in order to raise local latex quality to an acceptable standard. They also inspected the proposed factory site, analysed water quality and availability, and made recommendations for plant and equipment, personnel and training.

The feasibility study for a latex contraceptives manufacturing plant in Viet Nam was undertaken with the co-operation of the following executive staff officers in the Ministry of Health:

Dr. N. van Dong, Director of Bureau of External Relations

Mr. H. Eran Giap, Department of Esential Buildings and Materials

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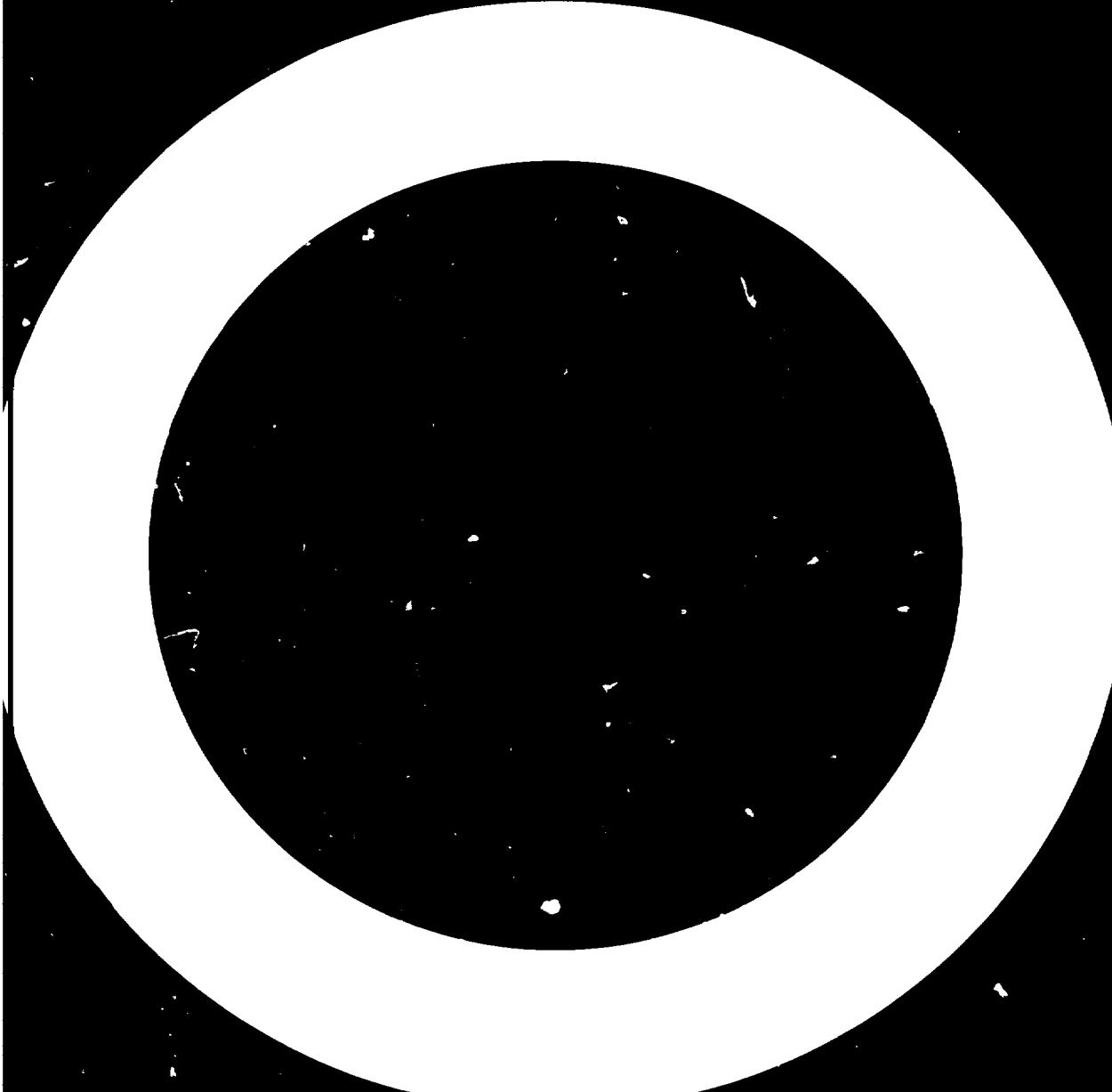

BACKGROUND

Viet Nam achieved independence and was re-unified after the liberation of Saigon, on 30 April 1975. The Ministry of Health, as the responsible central organ, began nation-wide family planning in accordance with a resolution of the Fourth Convention of the Labour Party, held in December 1976. As a consequence of the signing of the Assistance Agreement on Family Planning Activities between the Government of Viet Nam and the United Nations, a speed-up in activity began in order to achieve the objectives set by the Ministry of Health.

The Ministry of Health decided that one of the largest programmes in their family planning campaign was the establishment of a latex rubber contraceptives manufacturing factory, using local latex; in November 1977, a proposal for project assistance and other general programmes was submitted to the United Nations. As a result of the project proposal three consultants were sent by UNIDO to undertake a three-week study in August 1978 to examine the feasibility of building a latex contraceptives manufacturing factory in Viet Nam.

As the Ministry of Health had already programmed the use of 60 million condoms from 1978 on an annual basis the consultants were well aware of the Ministry's desire to have the latex contraceptives manufacturing plant working at the earliest possible date. It was pointed out in the course of discussions and research by the official responsible for technical work in this project that the condom quality must be equal to the Japanese products supplied by the Swedish International Development Authority (SIDA), and that the raw latex must be produced in Viet Nam. He also stated that non-fulfilment of either of these conditions would result in a negative decision with regard to a latex manufacturing factory for Viet Nam.

The consultants repeatedly explained the difficulty of manufacturing latex rubber contraceptives in a tropical zone, particularly if these were to meet the standards of Japanese and Malaysian products.

The difficulty of producing latex condoms was fully understood by the responsible official, and at the same time, he also appreciated the fact that the mere supply of machinery, equipment and technical know-how by a firm of latex contraceptives manufacturers was not in itself sufficient to ensure a high-quality condom manufacturing plant, unless a supply of high-quality natural rubber latex was available.

The feasibility study of a latex contraceptives manufacturing plant was carried out and took into account the following aspects:

(a) Availability of local latex for the production of condoms. A great effort is necessary to develop the high quality needed, and it is difficult to say when the refining technology can be regarded as reaching an acceptable level;

(b) As the use of local latex is a prerequisite, the problem must be overcome through a serious effort by the Ministry of Health with the co-operation of the suppliers of equipment plant and technical know-how, and the United Nations;

(c) A laboratory should first be established to study the refining technology, so that local latex can be developed to an acceptable level for the production of condoms. Chief of research for the laboratory should be at the professorial level in latex technology, and must have studied at the National Rubber Research Institute or the latex refining factory in Malaysia. The development of refining technology might be made much easier if the appointee was a staff researcher in the Institute of Rubber at Ho Chi Minh;

(d) An analysis of the water supply was made and the factory site was also evaluated. A building proposed as a factory was examined and found to be suitable after repair works had been carried out, and subject to the availability of the necessary water supply;

(e) An investigation was undertaken of items essential for a latex condom manufacturing plant - electrical power, transportation facilities, materials necessary for the repair of the factory building, machinery and equipment, packing materials and chemicals;

(f) A list of machinery and equipment and spare parts was prepared;

(g) The need for key personnel and the scope of management were considered as well as training programmes;

(h) An analysis of family planning procedures was made and the structure of the population was explained.

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INTRODUCTION

Population

Viet Nam has a population of about 50 million and an area of 330,000 km^2, with a density of about 145 inhabitants per km^2. The population growth rate in the north in 1976 was estimated to be 2.55%, and in the south, the rate in 1974 was estimated at 3%. Should these rates remain constant the population of Viet Nam will reach 100 million in 20 years.

Before 22 July 1976, Viet Nam was divided into two regions - north and south. Because of the war which lasted for more than 30 years, no population census was made in the south. Only in limited areas such as Ho Chi Minh City and in other provinces did population research take place. Population censuses in the north were made twice in 1962, the first year of family planning, and they showed a population growth rate of 2.9%, although it is believed that the population growth rate in 1974 was much lower (see table 1).

Table 1. Population growth rate in Viet Nam, covering period 1965-1976
(Per 1,000)

	Births	Deaths	Net natural growth
In the north			
1965	38.8	6.7	32.4
1972	36.0	7.0	28.0
1973	33.8	5.5	26.3
1975	31.3	5.5	25.8
1976	31.0	5.5	25.5
In the south			
1974	42.0	12.0	30.0

The Population Division of the United Nations was unable to estimate accurately the population in the south and its growth rate; as a result, the National Institute of Statistics in Viet Nam accepted a rate of increase of 2.6% from 1962 to 1965. During the last 10 years of the war there were good reasons to believe that the growth rate was lower than 3%. In fact, the frequency of pregnancies of married women and the number of marriages of young people were at a low level, since about 95% of the men aged 18-45 were mobilized for military service. Economic difficulties might also have postponed marriages and childbearing. In addition, the mortality rate was relatively high during the war.

Population after reunification

After reunification, it was estimated that about 2 million people were displaced from north to south (the majority of the displacements were carried out in large urban areas such as Ho Chi Minh City.) Hundreds of thousands of soldiers returned from combat zones, and some might have returned to rural areas where they had lived before. About 200,000 refugees left the country.

In February 1976 a general census of the population (north and south) was taken by the Government of Viet Nam in preparation for the elections in April 1976. The population of Viet Nam was then estimated at 47,149,900; i.e. 22,946,700 in the north (48.7%) and 24,203,200 in the south (51.3%) (see table 2).

Table 2. Population and density of Viet Nam by provinces and important cities

Province or city	Population (thousands)	Surface area (km^2)	Density (km^{-2})
North			
Hanoi (capital)	1 443.5	597	2 418
Hai-phong	1 190.9	1 515	786
Provinces			
Lai-chau	265.6	17 402	15
Hoang-lien-son	677.2	14 125	48
Ha-tuyen	686.1	13 519	51
Bac-thai	752.9	8 615	87
Cao-lang	343.9	13 781	61
Son-la	410.1	14 656	28
Vinh-phu	1 579.5	5 137	305
Ha-bac	1 466.2	4 708	311
Quang-ninh	701.8	7 076	99
Ha-son-binh	2 041.6	6 860	298
Hai-hung	1 929.9	2 526	764
Thai-binh	1 416.2	1 344	1 054
Ha-nam-ninh	2 574.6	3 522	731
Thanh-hoa	2 262.1	11 138	203
Nghe-tinh	2 704.6	22 380	121
Total	22 946.7	148 957	154
South			
Ho Chi Minh City	3 460.5	1 315	1 876
Provinces			
Binh-tri-thien	1 751.8	19 018	92
Quang-nam-Da-nang	1 414.4	11 376	124
Gia-lai-Cong-tum	465.0	13 480	25
Nghia-binh	1 789.1	14 700	122
Lac-lac	372.7	18 300	20
Phu-khanh	1 066.2	9 620	111
Lam-dong	343.1	10 000	34
Thuan-hai	836.9	11 000	76
Song-be	561.4	9 500	59
Dong-nai	1 260.3	12 130	104
Tay-ninh	625.9	4 100	153

(table 2 continued)

Long-an	828.3	5 100	163
Tien-giang	1 137.2	2 350	484
Ben-tre	932.0	2 400	388
Dong-chap	991.3	3 120	313
Cuu-long	1 319.1	4 200	314
An-giang	1 361.7	4 140	329
Hau-giang	1 870.4	5 100	366
Kien-giang	834.0	6 000	139
Minh-hai	981.1	8 000	123
Total	24 203.2	180 449	134
Total (north and south)	47 149.9	329 406	143

Source: Population Report, Population Division of the United Nations.

Family planning

Family planning became an official government policy in 1962. The Bureau for Mother and Child Health is the division responsible for the planning and management of national family planning, and the Institute for Protection of the Mother and the New Born has the responsibility at the central level for supervising regional units in all matters related to family planning, especially with regard to the management of programmes, techniques etc.

There are 38 maternal health stations (35 in the provinces and 3 in the cities), 500 district maternity units, 5,000 community maternity units, and 800 mobile teams composed of two or three assistant doctors and midwives. The role of mobile teams is, however, tending to be replaced by individual midwives with the result that the use of mobile teams is gradually decreasing.

It is estimated that the proportion of women of child-bearing age is 40% in the north and 70% in the south; the total number of married eligible women is estimated to be 5-5.6 million. Of this number, births should total not more than 1.5 million, in line with Government policy. During the past 16 years, 909,000 women were fitted with intra-uterine devices (IUDs), mostly in the north. In addition to the IUD, tubal ligation and vasectomy (for the husband), 3.4 million eligible women require some method of contraception.

The main contraceptive methods used in Viet Nam fall into two categories - one depending on contraceptives supplied from overseas such as latex condoms, IUDs, and the pill, and the other on domestic methods such as curettage, tubal ligation and vasectomy.

Owing to an insufficient supply of contraceptives and the shortage of gynaecologists and obstetricians, the Government has tried to instruct women in the Ogino-Knaus rhythm method and in coitus interruptus etc. For example, the planned target for implementation of family planning from 1978 to 1981 is as follows (per year):

IUD:	350,000-500,000
Condom:	1 million
Pill:	500,000
Curettage, tubal ligation and vasectomy:	500,000
Ogino-Knaus and others:	2 million

The IUD

The most widely-used method of contraception in Viet Nam today is the IUD, with which women can be fitted not only by doctors, but also by trained ancillaries as well as midwives from the clinics and maternity stations. This method is mainly used on State farms. The merits of the IUD can be found in its effectiveness, its long maintenance-free period, and in its low cost. IUDs made in Czechoslovakia, Japan, and the United States of America are popular in the country.

Oral contraceptives

Oral contraceptives have not yet been used in the north because of the trouble in taking them each day and for fear of side effects, but the pill has been used in the south by about 50,000 women. At present, the Government does not expect to rely on this form of contraception.

Latex contraceptives

In contrast to oral contraceptives which have been used in the south and the IUD - the main method used in the north - government policy clearly indicates

their great interest in latex condoms because of no side effects, ease of use, and because they have given satisfactory results. The Government's confidence in condoms is no doubt due to the large supply of Japanese products made available by SIDA from 1972 to 1976.

The Ministry of Health aims to supply latex condoms for 1 million people in 1978, allowing 60 pieces per married and eligible couple. This means that the need for condoms on an annual basis is a minimum of 60 million, although this figure has no scientific basis.

However, owing to a short supply of condoms - the main contraceptives in family planning - their distribution seems to be restricted to administrative personnel.

The consultants saw samples of condoms supplied by SIDA in 1974, which were still being distributed on a limited basis in a maternity unit in Hanoi. Because of stock shortages they were being forced to use them sparingly.

The Vietnamese preference in condoms is strongly in favour of the Japanese product, with the same size and quality as that used in Japan and Malaysia. Government specifications are:

Thickness:	Approx. 0.05 mm
Width:	48-50 mm
Length:	Not less than 17 cm
Colour:	Neutral (for the present time)
Lubrication:	Necessary

The Ministry of Health believes the Japanese condom to be thin enough and of sufficient strength. In the event of Vietnamese production it is essential to adhere to Japanese or Malaysian quality levels, i.e.:

Tensile strength:	200 kg/cm^2 (2,000 Pa)
Elongation at break:	700%
Tensile strength after aging:	200 kg/cm^2 (2,000 Pa)
Elongation at break after aging:	700%

Should it not be possible to meet these requirements, the Ministry of Health believes there is no advantage in manufacturing condoms in Viet Nam.

Assuming that a condom manufacturing factory is built on the planned factory site in Ho Chi Minh City, products will be distributed directly to the 38 provincial and city warehouses, and from there to district warehouses. Each dispensary, hospital maternity unit and mobile team will then receive the condoms from the district warehouses.

However, the general consumer cannot obtain condoms individually. A representative from each community must visit the district or community maternity hospital to get each week the contraceptives needed for his or her group.

The consultants visited one of the largest central warehouses in Ho Chi Minh City, but were unable to see a district warehouse. In the south, the products will be delivered to consumers every two to three weeks from factory warehouses, while it would need four to five weeks for delivery in the north. Though supplies of condoms are insufficient at present, the Ministry of Health is willing to supply enough stocks to the distribution chain of Japanese-standard quality condoms so as to enable the programme to progress effectively. Otherwise, its target will not only not be attained, but the programme itself will have to be postponed. No storage problem is foreseen for the 60 to 70 million condoms. Similarly, there should be no problem with regard to transportation as the goods are expected to be delivered by truck or boat to an area of Viet Nam in which there are good main roads.

District maternity unit in Hanoi

One of the most successful district maternity units in Hanoi is the Hai Ba Trung Maternity Medical Station. Its present structure is as follows:

Population:	230,000
Women of child-bearing age:	50,000
Birth rate p.a.:	2.03%
Growth rate p.a.:	1.7%
Abortion p.a.:	4,000
Condom use p.a.:	11,000
IUD to be used p.a.:	2,500 (25% of child-bearing age women already fitted)
Staff:	72
Doctors	6
Assistant doctors and midwives	36

Task description: Pregnancy testing

Treatment of obstetrical and gynaecological diseases

Family planning instruction

Campaign for family planning

Family planning campaign

In Viet Nam, people are urged to have a maximum of two children in urban areas and three in rural areas. The Ministry of Health reported that this demand is not only for the benefit of Viet Nam and for each family, but that it has echoed this call for all human beings since it first began advocating the importance of family planning.

The necessity for family planning is given publicity throughout the nation by radio and television and in cinemas which a publicity team visits each month. The most effective influence on women of child-bearing age is the frequent publicity given in a weekly newspaper issued to all women throughout the country. Furthermore, a team visits state farms, construction sites, and other enterprises to persuade people of the necessity for family planning.

As the co-ordinators for family planning, the Ministry of Health must appeal to the public through the mass media to use condoms, and the response indicates a number of condoms are needed as soon as possible.

The necessity for latex condom manufacturing

It is quite clear that the use of rubber contraceptives and a manufacturing factory in Viet Nam are essential, and the consultants' main object was to study the feasibility of establishing a latex condom manufacturing plant in the country.

The consultants were unable to study all the aspects of this problem to their entire satisfaction, as it was difficult to visit factories or laboratories belonging to any other Ministry than the Ministry of Health; for example, the National Institute of Rubber, a latex refinery factory, a latex products manufacturing factory, packaging material producers, and water supply offices etc., despite prior notice and repeated requests. They were therefore obliged to forego the opportunity of visiting these establishments. However, the members of the Ministry of Health and the official responsible staff were exceedingly

helpful in answering questions. The receipt of a sample of latex for re-analysis in Japan was unsatisfactory because of formalities, and on one occasion samples did not conform to the analytical data which are shown below.

Analysis of latex

Kind	Low ammonia
Total solid content	61.5% (min)
Dry rubber content	60% (min)
Difference between total solid and dry rubber	2% (max)
Ammonia content (on water phase)	0.8% (max)
Volatile fatty acid (K_oH 8/100 g of solid)	0.2% (max)
Mechanical stability	540 sec (min)
K_oH value	1 (max)
Coagulating matter	0.08% (max)
Cu	0.0008% (max)
Mn	0.0008% (max)

Notes: 1. Refining performed three times.

2. Method of refining: mesh 60 and 80 - twice daily, mesh 60 and once before centrifuge (mesh 80).

3. Speed of centrifuge: 1,450 rpm.

The consultants visited a rubber plantation, the planned factory building, and a pharmaceutical packaging factory in Ho Chi Minh City. They also had a number of discussions with the official responsible in the Ministry of Health and, as experts in quality condom production, were able to make their views known on all the important points.

Though an accurate analysis of latex and water must still be made in Japan, in comparing the analytical data given for these items by the authorities concerned, the latex currently produced in Viet Nam is considered far from an acceptable level from the viewpoint of producing Japanese- or Malaysian-grade quality latex condoms - a compulsory requirement of the Government of Viet Nam.

The importance of efficient machinery and equipment as well as technical know-how for the production of latex condoms cannot be ignored, but by the same token the fundamental importance of the latex itself and the refining technology used must not be overlooked.

The highest quality latex must be the most basic factor to be resolved for the manufacture of latex contraceptives in so far as a high-quality product is required. Highest quality latex should be available before the production of latex condoms begins; otherwise, the basic tenet of the Ministry of Health - Japanese- or Malaysian-quality condoms with Vietnamese latex - cannot be complied with.

A laboratory to develop latex and its refining technology should be established, as proposed by the Ministry of Health; at the same time, a rubber plantation can be allocated to the Ministry of Health, for use as a condom factory, as it is government property.

The laboratory should be built within the factory. The consultants had no objection to this proposal and felt it to be constructive as the National Institute of Rubber's aim is for the development of coagulated rubber and latex for general use and for export. The question of when such an advanced state of technology can be reached in Viet Nam could not be foreseen at present. It is regretted that the existing assistance agreement on rubber development between the Governments of Malaysia and Viet Nam will not be of much assistance, as the agreement has a different objective and is much more basic. A separate assistance agreement will be needed for the provision of more advanced technology.

It should, therefore, be noted that it is necessary to establish a laboratory for latex refining technology separately from the general laboratory required for the latex condom factory.

CONCLUSIONS AND RECOMMENDATIONS

The United Nations office estimates Viet Nam's condom requirements over a four-year period to be 30 million pieces annually, at a yearly cost of $US 1.6 million. The actual requirement is 70 million pieces per year and as the Government of Viet Nam particularly wishes to order a Japanese condom, the price quoted in this instance by the United Nations office is incorrect since the price of the Japanese condom is double the budget forecast by the United Nations office.

However, the United Nations will assist the Government of Viet Nam over the next five years by supplying condoms for a total budget cost of $US 7 million. If Japanese condoms are purchased, a budget of $US 14 million would be required. In the light of a technical-economic feasibility study for local production, both figures represent a very high cost and a more economically sound method has to be considered to provide such a large number of condoms. This would not only make economical use of the five-year budget but also create an infrastructure which could function later, and enable the Government to satisfy its needs with the minimum of foreign exchange.

Malaysian experience should be considered and co-operation between Viet Nam and Malaysia for the training of technicians and the exchange of experience should be implemented.

Viet Nam has requested the United Nations Fund for Population Activities (UNFPA) to assist it in implementing these objectives as it feels that the success of any programme, including family planning, depends on self-reliance and self-sufficiency in the products involved.

The production of condoms is, however, quite an intricate and sophisticated operation, and the quality of the condoms produced depends greatly on the quality of the latex. Therefore, for local production of condoms in Viet Nam, the utilization of local latex can only be considered if this is of a sufficiently high quality.

Should latex of this quality not be found in Viet Nam, an alternative approach would be to produce condoms from good quality imported latex. This operation would also be economically sound as the price of condoms produced locally based on imported bulk materials will be only a fraction (in terms of foreign exchange) of imported ones.

During the process of establishing local production of condoms based on imported bulk latex, it is certain that the quality of local latex could be improved. Once this quality has proved to be acceptable for condom production, there should be no problem in producing condoms from local latex.

Recommendations

Local production of condoms in Viet Nam is strongly recommended and could be planned in the following stages:

1. Packaging of imported bulk-tested condoms.[1/]

2. Packaging and testing imported non-tested bulk condoms.[1/]

3. Production of condoms from imported latex.

4. Production of condoms from locally available latex.

5. Establishment of a quality-control laboratory. The estimated cost of the equipment for the quality-control laboratory is $US 53,000.

6. Along with the third and fourth stages, the technology for the production of local latex has to be improved. Scientific and technical knowledge has to be improved in order to produce high quality latex. Since this activity is of a more scientific and technical nature, a separate project dealing with this matter has to be developed. UNIDO should provide experts to evaluate existing technology and latex quality, who would then suggest the best way to improve quality. In the meantime it is important that Viet Nam sends a latex sample to Japan as soon as possible for analysis by the group of experts who recently visited Viet Nam.

7. The presence of sufficient good quality water is essential for a latex condom manufacturing factory. The amount of space and the site are not entirely satisfactory, but would be acceptable for the production of the proposed number of condoms and the required laboratory. In the feasibility study of the existing factory buildings, the consultants found the central warehouse, which was built seven years ago by the Ministry of Health in south Viet Nam, to be satisfactory. This would, of course, need to be repaired as described in this report and provided with good quality well water in sufficient quantity.

1/ These levels of production could be introduced immediately and expanded to stage 3 very easily.

3. Viet Nam strongly wishes to construct the same type of unit as exists in the Malaysian factory with a laboratory for latex condom manufacturing technology; that is, with a production capacity of 70 million pieces/year operating 24 hours daily. It is perfectly understandable for Viet Nam to want exactly the same plant from the suppliers of the equipment and know-how in Malaysia, as these are the only successful suppliers in the tropical zone. The same approach should be taken by the United Nations if they agree to make the large investment involved.

Details of these recommendations and investment costs are given below.

Stage 1. Packaging imported bulk-tested condoms

As Viet Nam wants to have a factory in 1978, the decision to install packaging machinery for the supply of bulk condoms can be strongly recommended as a first stage, because a successful start at an early date is promised, and the investment may be split. In this case, operation will start within one year provided that the repair of the factory building and the installation of an electricity supply are completed ahead of schedule (see figure I).

On the assumption that the facilities are ready to begin operating within 12 months, the actual packaging can start one month later, and the investment in the first year is expected to be about $US 3 million with the following cost breakdown:

	$US
Cost of 70 million condoms (Japanese origin)	1,670,000
Packaging equipment etc.	177,000
Quality-control laboratory	53,000
Building and other facilities	1,100,000
Total	3,000,000

The amount spent on the import of condoms will be spread in instalments throughout the year and need not be invested in one sum.

Stage 2. Packaging and testing of imported non-tested bulk condoms

When non-tested condoms are imported in bulk, the cost may be reduced by 10 per cent. It is suggested that an electronic pinhole-testing machine be

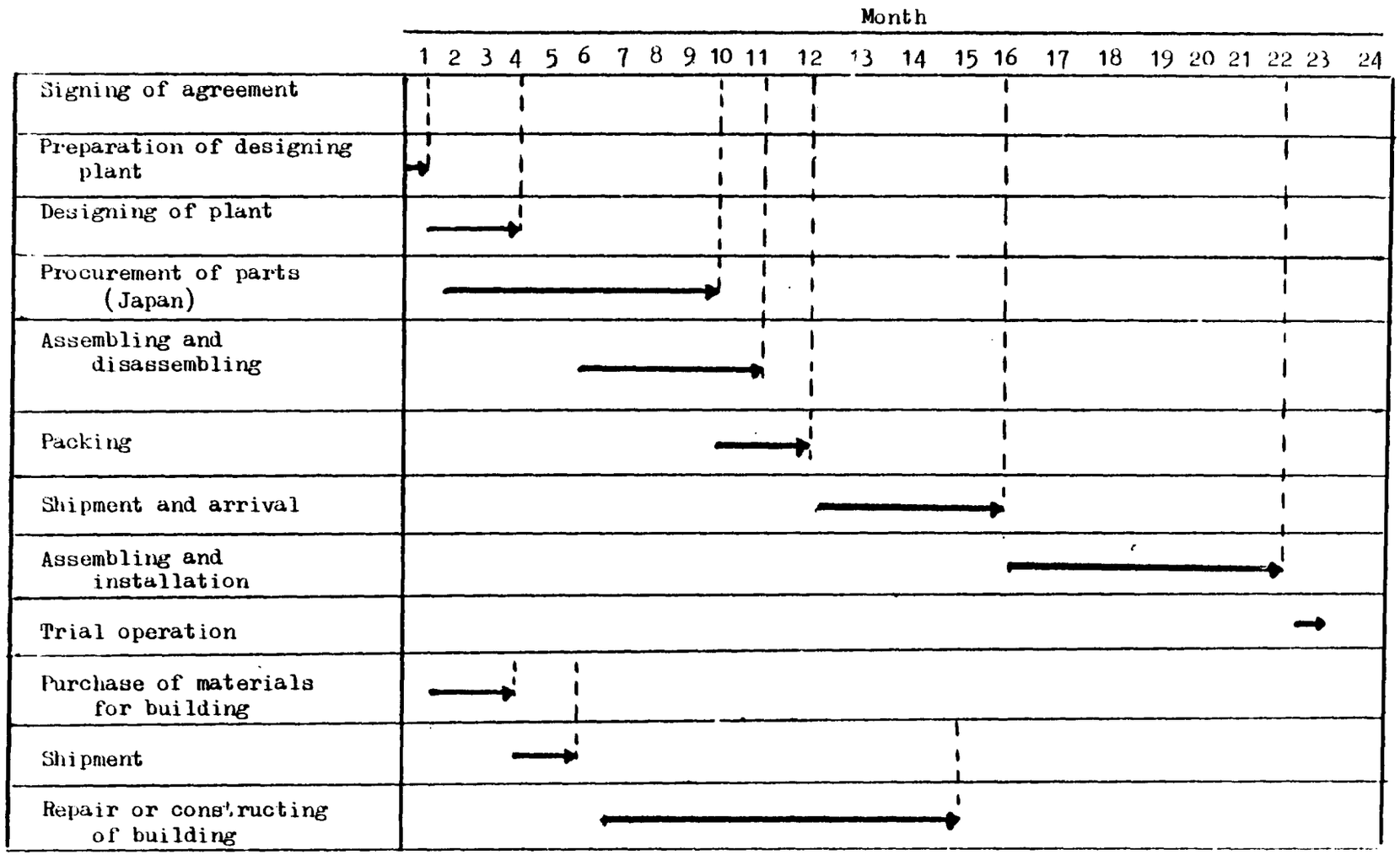


Figure I. Schedule of construction, installation and operation

installed, simultaneously with the packaging machine, in order to test the condoms.

The installation of the testing machine will take about six months and it will cost $US 400,000 in addition to the packaging equipment, quality control laboratory, building and other facilities indicated above. The total investment will amount to $US 3,233,000.

Stages 3, 4 and 5. Production of condoms from imported latex or locally available latex

(a) Plant machinery and equipment

To achieve a condom capacity of 70 million pieces per year on a 24-hour working basis, the investment in machinery and equipment will amount to $US 3,193,357 as indicated below:

(i) Basic equipment - the basic equipment will cost $US 2,288,573 and includes an automatic moulding machine, an electronic testing machine, a packaging machine, and laboratory equipment for testing condoms and raw materials;

(ii) Energy and power equipment, supply pipes and workshop - these are expected to cost $US 904,784 and include:

Boiler
Water tank
Pump
Electric substation and transformer
Electric wiring
Generator
Lighting fixtures
Parts for supply pipes and pipe fittings
Tools for construction
Equipment for the workshop

Shipping charges and sea freight are included in the above estimates for plant machinery and equipment;

(b) Raw materials and packaging materials

The cost of raw materials, local and imported latex, compounding and treating chemicals, and packaging materials is estimated at $US 452,392 and includes:

(i) Raw materials

Natural rubber latex
Compounding chemicals
Treating chemicals

(ii) Packing materials

The costs for polyethylene-laminated aluminium tape are estimated on a c.i.f.-Saigon basis, but prices of such materials fluctuate;

(c) Experts/engineers

An amount of $US 271,436 will be required for the various experts/ engineers required in Viet Nam as listed below:

Title	Number	Period required (months)	Man-months
Co-ordinating manager	1	10	10
Chief engineer	1	3	3
Mechanical engineer	2	6	12
Electrical engineer	2	6	12
Chemical engineer	2	6	12
Total	8		54

	$US
54 man-months x $US 4,790	258,660
Air travel, 8 x $US 1,597	12,776
Total	271,436

Additional expenditure will be incurred should further extensions of the above periods be necessary;

(d) Spare parts

The cost of parts over a period of five years is estimated at $US 149,023;

(e) Building

There are two alternatives: one is to utilize the existing buildings used as the central warehouse for pharmaceutical products; the other, as proposed by the representative of the Ministry of Health, is to build a new factory about 10 km from the centre of Ho Chi Minh City. Although construction work is to be undertaken by the Ministry of Health, it is desirable to appoint a supervising engineer for the construction of the building. The costs are as follows:

(i) Existing building to be used after reconstruction

The cost is estimated at $US 228,857;

(ii) New factory building

The cost is estimated at $US 851,562
Engineer: 3 x 2 months = $US 33,530;

(f) Know-how fee

A know-how fee for the manufacture of high-quality latex condoms is required and it is expected to cost $US 425,781;

(g) In addition to the above, if in the opinion of UNIDO and the Government of Viet Nam, after-care were required, a separate agreement can be entered into. At this stage, no estimate can be given as to the fees involved:

(h) It is felt that a preparatory amount (at least 10%) should be held in reserve as this is a very large and complex project, and since it is not clear what is going to happen after the first year of operation;

(i) Schedule of construction, installation and operation

The schedule for building repairs or the construction of a new factory building, installation and operation is shown in figure I;

(j) Observation of outside plants

There are two condom factories in India - one built with Japanese collaboration at Trivandrum and the other with British collaboration at Madras. A condom factory was also built with Japanese collaboration in Malaysia as a joint venture. The consultants recommended that representatives of the Ministry of Health and UNIDO visit one or more of these factories in order to appreciate the sophisticated nature of such plants working under tropical conditions.

Summary of investments

	$US
Plant machinery and equipment	2,288,573
Energy and power equipment, supply pipes and workshop	904,784
Raw materials and packaging materials	452,392
Experts/engineers	271,436
Spare parts	149,023
Building repair	228,857
Know-how fees	425,781
Total (on the basis of repairing the existing building)	4,720,846
New factory building	351,362
Experts for new building	33,330
Total (on the basis of constructing a new building; less building repair of $US 228,857)	5,377,081

Any after-care fees and the preparatory fund would involve additional costs.

Summary

In the first stage, all 70 million pieces will be packaged locally, and 8 hours' operation each day should be sufficient. Electronic-testing machines

can only be operated for about 10 hours each day: this is within the permitted operational times as far as the electricity supply is concerned.

Even if the whole project were to begin immediately it would not be possible to produce 70 million pieces, although the machinery would have sufficient capacity, because of the need to conserve electricity (see chapter IV for further details). The cost of materials will thus be less, but when 24 hours' operation is achieved the estimated costs will be reached.

A further recommendation which should be considered, together with those mentioned above, is that all machinery and equipment, including accessories, should be procured from one specialized producer, because each manufacturer adjusts his technology to the latex received from the refinery. The technology involved in manufacturing latex condoms is complicated, especially in the tropical zone, the condition of the latex differing slightly according to circumstances, temperature, time, and refining technology etc. To purchase machinery and supplementary equipment from different manufacturers is not recommended as it is probable that such machinery and equipment will be incompatible with that of other producers. Therefore, it is much safer to purchase all the manufacturing facilities, together with the technical know-how, from one manufacturer.

The Government of Viet Nam is extremely anxious to acquire plant and machinery from the Japanese producers who have already succeeded in manufacturing Japanese-grade condoms in Malaysia, in a similar tropical zone to Viet Nam. No other successful factory exists which meets Vietnamese requirements, especially in tropical zones.

UNFPA/UNIDO follow-up

It will be necessary for UNIDO representatives to visit Viet Nam to negotiate further with the Ministry of Health. The first requirement is to request the Government of Viet Nam to send samples of latex to Japan, as promised, for separate analysis.

Secondly, the Government of Viet Nam may propose establishing a laboratory for latex refining technology. Negotiations may be needed on this subject as it is beyond the control of the latex condom manufacturers.

A decision concerning the factory site is also important. In this connection, an analysis of the well-water supply will be required. It is also important to know its extent.

I. RAW MATERIALS

Natural rubber latex and compounding chemicals

High quality latex is required for the production of condoms, and attempts should be made to produce high quality latex in Viet Nam. To do so, many important factors have to be considered, such as plantation, production and collection, details of which follow.

Rubber trees

Generally speaking, the best type of tree for the extraction of latex is Hevea brasiliensis. There were no problems with the trees that were observed, but the plantation which was inspected had not been well kept.

For good quality rubber, the important climatic factors are high temperature and humidity, with little wind and an absence of typhoons. It should be in a tropical area of about 15° S latitude and there must be an adequate labour force and convenient transport facilities. In this respect south Viet Nam has a tropical monsoon climate with great humidity, high temperatures and does not experience typhoons. It has the desirable climatic conditions for the cultivation of high quality latex.

After the tree reaches 5-7 years of age, tapping of the bark is carried out with a knife. In Viet Nam the same extraction methods are used as in Malaysia, where the latex is produced for the latex condom.

The Government of Viet Nam has just entered into an agreement with the Government of Malaysia to acquire expertise in general rubber technology up to the level of export quality standard, in four stages - first to exchange technicians, secondly to provide testing equipment, thirdly to provide an experimental factory, and fourthly to build new plantations - with no time-limits after successfully concluding each stage. Therefore, for those who are studying under the present assistance agreement within a few years will be in a position to manufacture the much higher quality latex suitable for condoms.

Tapping the rubber trees must be done at the latest by 9 a.m., as the flow of milky latex from the tree in the early morning is the most abundant. The latex can be collected in a cup fastened to the tree.

Care must be taken to see that rain and dust are excluded, especially in the rainy season. In this respect, the plantation the consultants observed was

carefully managed (except that it was too old and had a rainy season lasting for six months). Should similar care be practised on other rubber plantations in Viet Nam, much of the consultants' concern may be unnecessary.

The average tree yields about 100 ml at each tapping and the collection of latex reaches a peak at 14-15 years and decreases gradually. The average life of a rubber tree is 20 years, although the age of trees observed about 50 km south-east of Ho Chi Minh City exceeded that age.

The consultants were also concerned about the quality of the natural rubber latex produced in Viet Nam and whether it was suitable for the production of latex condoms. Further, anxiety was felt owing to the long war period; 30% of rubber trees had been damaged. The composition and characteristics of latex are largely influenced by the soil of the plantation, climatic conditions, level above the sea, deciduous and fruition seasons, age of tree, and tapping time. In addition, refining technology was regarded as a highly important factor in producing good and better quality latex. Each refinery might have its own technology in the same way that each condom producer has different compounding technology.

At the time of centrifuging, different chemicals in different amounts might be added according to the conditions mentioned above, and for extremely thin film products, as used in latex condoms, careful attention is required.

Therefore, the basic requirement in utilizing the local latex is to enhance its quality and to use only quality latex for the manufacture of condoms. Gradual improvements after the necessary analysis of natural rubber latex are needed.

Two 100-litre bottles of sample latex were supplied to the consultants for analysis, but en route to Japan for re-analysis, it was discovered the sample did not comply with government formalities. Therefore, only the data provided by the Government of Viet Nam is described on page 17. This was submitted in August 1978.

From the given data it is thought the product might be suitable as the raw materials for the manufacture of general latex products such as balloons and household gloves, but it is not thought at present that the latex is of sufficient quality for the manufacture of the extremely thin film which must remain strong over a period of a number of years.

High-quality latex must, first, be produced. For this purpose, detailed specifications of the required latex should be given to the natural rubber refining factory. At the same time, as the formulation and characteristics of the latex changes, the specifications should be checked and recorded so as to fully understand the variations undergone by the latex.

The necessity of having a laboratory, testing equipment and researchers is clear. In the laboratory, a concentrated research effort is needed to develop and improve existing latex to the level specified at the later stage.

Naturally, the importation of latex must be allowed until a high quality latex is capable of being manufactured in Viet Nam.

Summary of situation in Viet Nam

The latex requirements of the Ministry of Health cannot be fulfilled until good contacts are established with the Ministry responsible for the refining factory.

Refining technology is not high at present as the enhancement of general rubber technology has just begun with the collaboration of the Malaysian National Institute of Rubber. More sophisticated technology cannot be expected under the present technical assistance agreement between the Governments of Malaysia and Viet Nam.

It should be realized that a laboratory cannot yet be established in the Ministry of Health as no building, equipment or specialist technicians exist at present.

A condom manufacturing factory does not need any latex refining technology, although the required specifications can be given to the refinery firm or laboratory. The technology for refinery operations must be obtained from the refinery company.

Besides the need for high quality latex, there are a number of compounding chemicals necessary for the manufacture of latex condoms. Manufacturers of latex condoms do not disclose the details of the chemicals used as many of them belong in the technical know-how category which is acquired as a result of various experiments in their production experiences, especially with regard to manufacturing high-quality condoms. The general categories of compounding materials may be described as follows:

Vulcanizing agent - sulphur

Vulcanizing activator - zinc oxide

Vulcanizing accelerator - many chemicals to choose from

Dispersing agents - chemicals are necessary. Mis-use might cause the compounded latex to become useless

Anti-oxidants - chemical protects against deterioration through ageing

Stabilizers - chemical helps to obtain constant quality products

Special compounding ingredients - each producer adds different chemicals from the above categories to his products to obtain a special quality

Supply of compounding chemicals - because natural rubber latex is delicate it varies in quality, even though the same amount of chemicals may be used, and thus careful attention must be given to the order in which the chemicals are added and to their quality. It is impossible to obtain a supply of the compounding chemicals in Viet Nam, and the firm supplying plant and machinery should be in a position to provide all the chemicals needed

Other chemicals - chemicals for analysis, water treatment, cleaning moulds, stripping condoms from moulds, protection against stickiness, testing and lubrication

The quantity and use of all these chemicals varies from producer to producer in accordance with the nature of the natural rubber latex, temperature, humidity, machinery, equipment etc. Each manufacturer's technical know-how describes in detail how the chemicals are employed.

Water

At the factory site located in Ho Chin Minh City, water is available and an analysis of water by the city water supply office is shown below.

Analysis of city water in Ho Chi Minh City

Temperature	$25^{\circ}-29^{\circ}C$
Turbidity (ppm)	<5
pH	8-8.5
Total hardness (ppm as $CaCO_3$)	20-25
Ca hardness (ppm as $CaCO_3$)	15-20
Mg hardness (ppm as $CaCO_3$)	5

Temporary hardness (ppm as $CaCO_3$)	20-25
Permanent hardness (ppm as $CaCO_3$)	0
Alkalinity (M) (ppm as $CaCO_3$)	20-25
Cl^- (ppm)	1
SO_4^{--} (ppm)	Trace
Iron (ppm as Fe)	< 0.2
SiO_2 (ppm)	7-20
Colour	5-10
Specific electric conductivity (micromho/cm)	20-30

A well-water analysis submitted by the city water supply office follows. This records water taken 20 meters below the surface.

Analysis of well water in Ho Chi Minh City

Turbidity (ppm)	50
pH	4.25
Total hardness (ppm as $CaCO_3$)	6
Ca hardness (ppm as $CaCO_3$)	6
Mg hardness (ppm as $CaCO_3$)	Trace
Temporary hardness (ppm as $CaCO_3$)	2
Permanent hardness (ppm as $CaCO_3$)	4
Alkalinity (M) (ppm as $CaCO_3$)	2
Cl^- (ppm)	Trace
SO_4^{--} (ppm)	0
Iron (ppm as Fe)	2.4

Well water, 6-7 metres below the ground surface registered 28°C, 50 metres from the expected factory site, whilst the outside temperature at the time was 29°C. Data compiled by the consultant in Japan is shown below.

Japanese analysis of well water

Turbidity (ppm)	0.6
pH	5.72
Total hardness (ppm as $CaCO_3$)	66.0

Ca hardiness (ppm as $CaCO_3$)	55.0
Alkalinity (M) (ppm as $CaCO_3$)	28.0
Cl^- (ppm)	57.7
SO_4^- (ppm)	33.0
Iron (ppm as Fe)	0.05
SiO_2 (ppm)	3.9
$KMnO_4$ consumption (ppm as $KMnO_4$)	20.16
Colour (ppm)	5.4
Mn	-
NO_3^- (ppm)	-
NH_4^+ (ppm)	-
Specific electric conductivity (micromho/cm)	429

Note: Well water in Ho Chi Minh City taken on 15 August 1978, and tested in September 1978.

Manufacture of latex condoms and quality of water

The second most important factor for the manufacture of latex condoms is the quality of the water, and although city water is available and is analysed on page 27, it will be impossible to rely on city water, as the supply might be suspended or cut off and large quantities are constantly needed. Although the cost of city water is not high it is suggested that well water also be used, the shortage of water in the future when industrialization enters into full swing being taken into consideration.

The Ministry of Health has promised geological assistance in securing a substantial good water supply. The factory site is located 60 km from the sea, and the Mekong river near the site is saline for only 6 months during the rainy season.

To obtain good quality water at the factory site, the existence of salinity in the well water must be carefully checked. As the quantity of well water is changeable, a deep well must be dug so as to acquire good quality water.

Should the well water prove to be saline, it cannot be used for the manufacture of latex condoms. Caution should be paid to the iron content, as this will have a bad effect in various areas. Other aspects regarding the quality of water must also be checked before bores are made.

The Ministry of Health is confident in this respect, and it is hoped that no serious problem in the water supply exists. However, a change of factory site must be considered should this be the case.[2/]

Japanese analysis of city water

Turbidity (ppm)	0.8
pH	6.88
Total hardness (ppm as $CaCO_3$)	23.0
Ca hardness (ppm as $CaCO_3$)	18.0
Alkalinity (M) (ppm as $CaCO_3$)	16.0
Cl^- (ppm)	6.5
SO_4 (ppm)	-
Iron (ppm as Fe)	0.15
SiO_2 (ppm)	13.0
$KMnO_4$ consumption (ppm as $KMnO_4$)	1.94
Colour (ppm)	3.4
Mn	-
NO_3^- (ppm)	-
NH_4^+ (ppm)	-
Specific electric conductivity (micromho/cm)	59.7

Note: City water in Ho Chi Minh City taken on 15 August 1978 and tested in Japan, September 1978.

Packaging of bulk condoms

Latex contraceptives are generally picked in laminated tape and then placed in paper boxes for consumer use.

After testing individual condoms, each piece is packed in laminated tape with polyethylene by a heat-sealing machine. Attention should be given to various

2/ Analysis of city water in Japan, 13 September 1978 (see table above), showed that the city water is acceptable for the manufacture of condoms. However, analysis of well water (see pages 32 and 33) showed it to be unsatisfactory owing to excess Cl^- and consumption of $KMnO_4$, as well as too large a specific electric conductivity etc. Therefore, a deeper well or a new factory site is recommended.

aspects of the warehouse, to transportation, climatic conditions, keeping properties, availability of packaging materials, preference of consumers etc.

The Vietnamese are willing to use lubricated condoms and as a result the packaging material must be leak-proof. Paper packaging is not recommended.

The warehouse should be protected against ants and other insects, as these pests destroy paper materials as well as the latex condoms.

Condoms manufacture are affected by high humidity and temperature, and they should be promptly packed into laminated foil to avoid too lengthy exposure to the air.

Paper is the only available packaging material in Viet Nam but this is not recommended for use because of the presence of ants and the high humidity. Polyethylene laminated cellophane or aluminium must be imported, as the laminating technology does not presently exist in Viet Nam. Polyethylene laminated cellophane or aluminium tape can be recommended as the packaging material, however, aluminium tape is more expensive than cellophane. All packing materials must be provided by the suppliers of plant and know-how at least for a period of five years.

	μ
Cellophane # 300	20
Polyethylene	50
Cellophane # 300	
Polyethylene	15
Aluminium	7
Polyethylene	40

Printing must be made on the laminated foil and the consultants recommend laminated packaging materials in accordance with the requirements of lubricated condoms and the various conditions in Viet Nam.

Condoms packaged in laminated tape should be packed in paper boxes in units of a dozen or a gross. There are no problems in Viet Nam in this connection as such paper packaging is available in the country.

II. FACTORY SITE

One important factor in the establishment of a latex condom manufacturing factory is the natural environment of the factory site. A feasibility study of the proposed site in Ho Chi Minh City shows the following with regard to temperature, humidity, rainfall etc.

The average annual temperature in Ho Chin Minh City is about 27°C. As a result it is evident that the latex condom manufacturing factory is to be built in a tropical zone, and one should take into account the fact that one of the largest European manufacturers of latex condoms has gone on record as saying that it is utterly impossible to produce latex condoms successfully in a tropical country.

However, the one exception is Malaysia, which has been able to make Japanese-grade quality condoms to the satisfaction of the Government of Viet Nam. If the technology in Malaysia could be brought to Viet Nam, which has similar climatic conditions, except for the six months' rainy season, there could be a chance of establishing a successful condom factory in this country.

According to the data supplied by the Ministry of Health, the annual average humidity is 79.5% and high humidity in Viet Nam is constant throughout the year. This might cause problems from the standpoint of drying, mustiness, and difficulties with electric appliances, although this problem could be overcome by selecting experienced suppliers.

It is clear that in Ho Chi Minh City there are two typical seasons: rainy and dry, each lasting for six months.

From May to November rain falls heavily, while from December to April it is completely dry. From the viewpoint of a condom manufacturing plant, this will not be of vital importance.

Several typhoons strike parts of Viet Nam each year, but none is expected to hit Ho Chi Minh City, nor are floods or thunderous conditions anticipated.

Ho Chi Minh City is not situated within a volcanic chain and is thus not subject to earthquakes; as a result the building may be constructed with locally made bricks.

Location

Located 60 km from the sea, Ho Chi Minh City is served by the Mekong River, and large steamships can reach the city. There is an international airport, a railway station, and well-established roads for trucks.

Sanitation

There are many insects such as mosquitoes, flys and ants, as well as pests such as rats, and from this viewpoint, the factory site is undesirable, unless protective measures are taken.

No problems are expected in sanitary conditions from the sudden increase in population by post-war migrants from the north and from rural areas. Nor is any problem foreseen through the occasional suspension of city water supplies.

Conclusions

Several problems are posed by the proposed factory site in Ho Chi Minh City. First, high temperatures and humidity are undesirable elements in the manufacture of extremely thin latex products. Natural rubber latex is easily influenced by temperature and humidity because of its vegetable origins.

The only successful producer in the tropical region making the same quality level as JIS T-9111 is located in a factory in Malaysia, established as a joint venture with Japanese producers.

The consultants are therefore of the opinion that the condom-manufacturing factory should be established with the collaboration of the same Japanese producers who succeeded in Malaysia.

Secondly, attention must be given to protection against possible damage caused by insects. Ants are a special pest and can easily enter into the packaged condoms; this problem must be taken into consideration when protective measures against such pests are prepared. Thirdly, the factory must be equipped with a complete ventilation and air-conditioning system.

III. EXAMINATION OF EXISTING BUILDING

An examination of the factory site was made from various aspects. Located at 38 Truong Quoc Dung Street, Ho Chi Minh City, in the centre of the city and the residential area, it is presently used as a warehouse for pharmaceutical products under the management of the Ministry of Health.

Approximately 60% of the space is being utilized for the storage of medical goods and materials. It was built for storage purposes, and in order to use it as a latex condom manufacturing factory it would require some repairs and improvements. The building is divided into rooms to satisfy storage conditions for each pharmaceutical product.

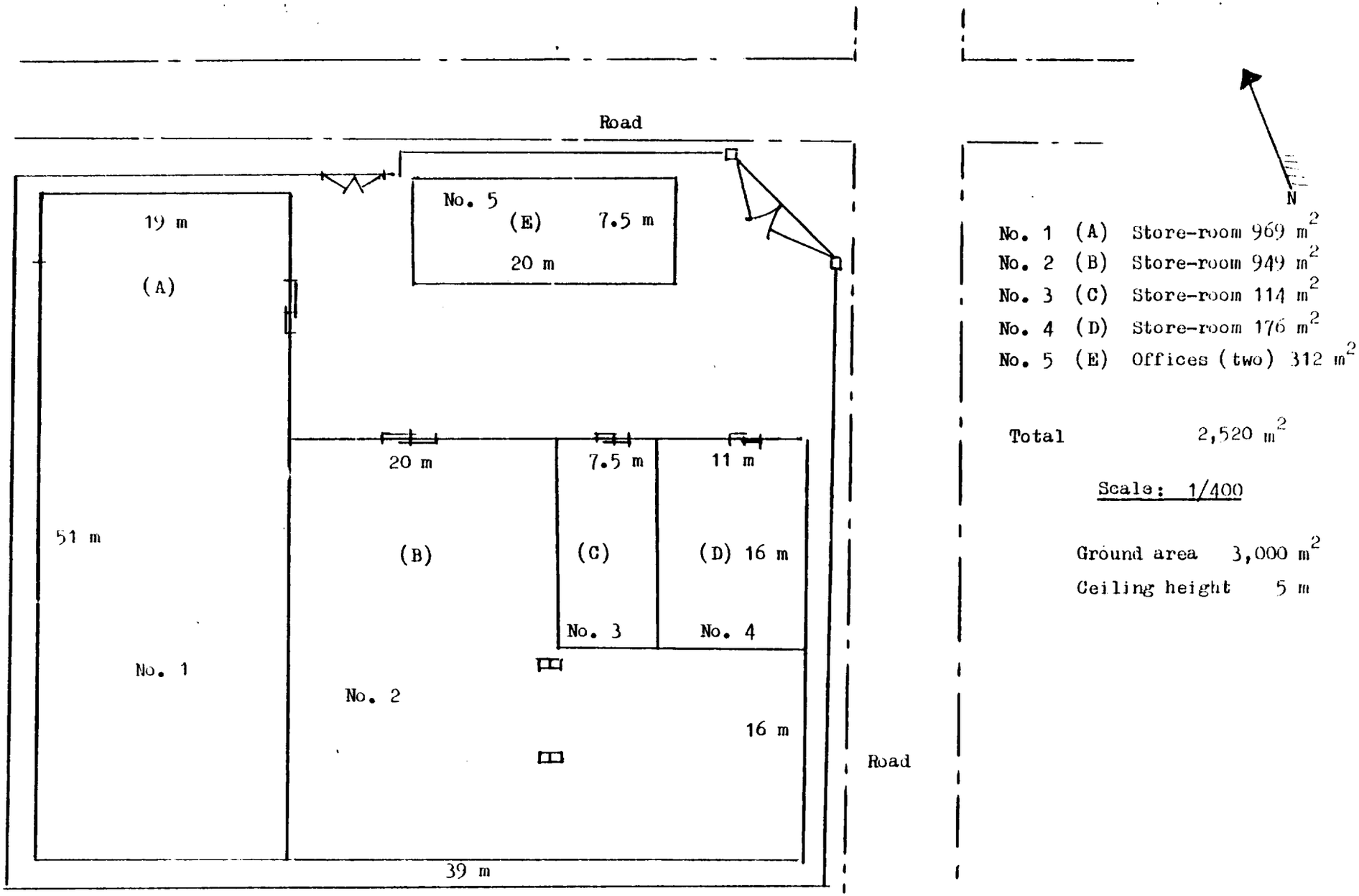
However, all the rooms have the same basic construction - as far as the ceilings, walls, floor materials and window openings are concerned. Some rooms are already air-conditioned.

Floor space (see figure II) is as follows:

Room No.	m^2
1	969
2	949
3	114
4	176
5	312 (two offices, 156 m^2 each)
Total	2,520
Total ground area	3,000

Gates and doors are sufficiently wide to allow plant and machinery to be brought in without difficulty. The building was constructed in 1970, and foundations, floors, walls and roof are sound, but for appearances, re-painting of the outside walls is recommended. The space is sufficient and with proper layout a condom manufacturing plant can function satisfactorily.

The separate building housing the two offices is divided and it would be difficult to use it as a part of the factory. It can be used as an office/laboratory, but as there is no door between the two rooms - each is independent - windows or doorways in the rooms are required.



No. 1 (A) Store-room 969 m^2
No. 2 (B) Store-room 949 m^2
No. 3 (C) Store-room 114 m^2
No. 4 (D) Store-room 176 m^2
No. 5 (E) Offices (two) 312 m^2

Total 2,520 m^2

Scale: 1/400

Ground area 3,000 m^2
Ceiling height 5 m

Figure II. Factory site, Ho Chi Minh City

Electricity supply

The electricity supplied to the factory consists of 220 V, 50 Hz, 3-phase, 200 A and 110 V, 50 Hz, single-phase, 100 A.

As a storage warehouse there is sufficient capacity, but it will be insufficient as a latex manufacturing factory. A new electric substation and high capacity electric wiring will be required as described in detail later.

Water supply

The warehouse is dependent on city water although there is a shallow well next to the office building. There are problems from the viewpoint of water quality because of the shallowness of the well, and the consultants have asked the Ministry of Health to allow a local geologist to study the possibility of obtaining better quality water from a deeper well.

A condom manufacturing factory requires large quantities of good quality water, and as a result it is necessary to provide well water. For drainage purposes there is no problem as a drain exists just outside the factory. Caution is needed to prevent contaminated water from overflowing.

A boiler and generator are not required for the building's present purpose, but if used as a latex condom manufacturing factory, this equipment will be necessary.

Preventative measures against noise, smoke and other discharges will be required as the factory site is located within the residential area.

The space is large enough for the proposed production capacity of 70 million pieces over a 24-hour working day. Rooms should be divided according to each process, as follows:

Processes

Compounding

No dust
No insects
Good ventilation
Sufficient drainage
Low temperature
Large door for passage of raw materials

Moulding

No dust or insects
Large space
Steam discharging pipe
Air-tight shutter

Vulcanizing

Ventilating apparatus for hot air
General ventilation apparatus
Sufficient drainage

Pin-hole testing

No insects
Ventilation apparatus
Well-illuminated and good ventilation

Packaging

No insects
Well-illuminated and good ventilation

Inspection

Well-illuminated and good ventilation

Repair of factory building

The consultants recommend the repair and improvements to the existing warehouse as follows:

Room 1: To be used for compounding and moulding

Six ventilators in the roof of the factory
Wire or plastic mesh on the roof fan
Windows to be fitted in a north-west and north-east direction
Mercury lighting to be installed throughout
Partial lighting to be included in the supply of plant
Doors to be made in the walls of rooms 1 and 2
Door to be 2-metres wide
Wire mesh on each window

Room 2: To be used for vulcanizing, pin-hole testing and packaging

Vulcanizing process room to be closely sealed and ceiling ventilation to be installed

Window to be fitted in a south-west direction

Pin-hole testing and packaging rooms require windows as well as ceiling ventilation

Room 3: To be used as boiler, generator and maintenance shop

Divided into three rooms and an entrance door in each is to be installed in a north-west direction

Ceiling ventilation is required and gas discharging apparatus supplied as necessary

Room 4: To be used as warehouse

Ceiling ventilation

No window is needed

Room 5: To be used as office and laboratory

Repair not necessary

During installation and repair work, drainage facilities can be improved as large quantities of water are needed. U-shaped drainage is necessary as shown in figure III.

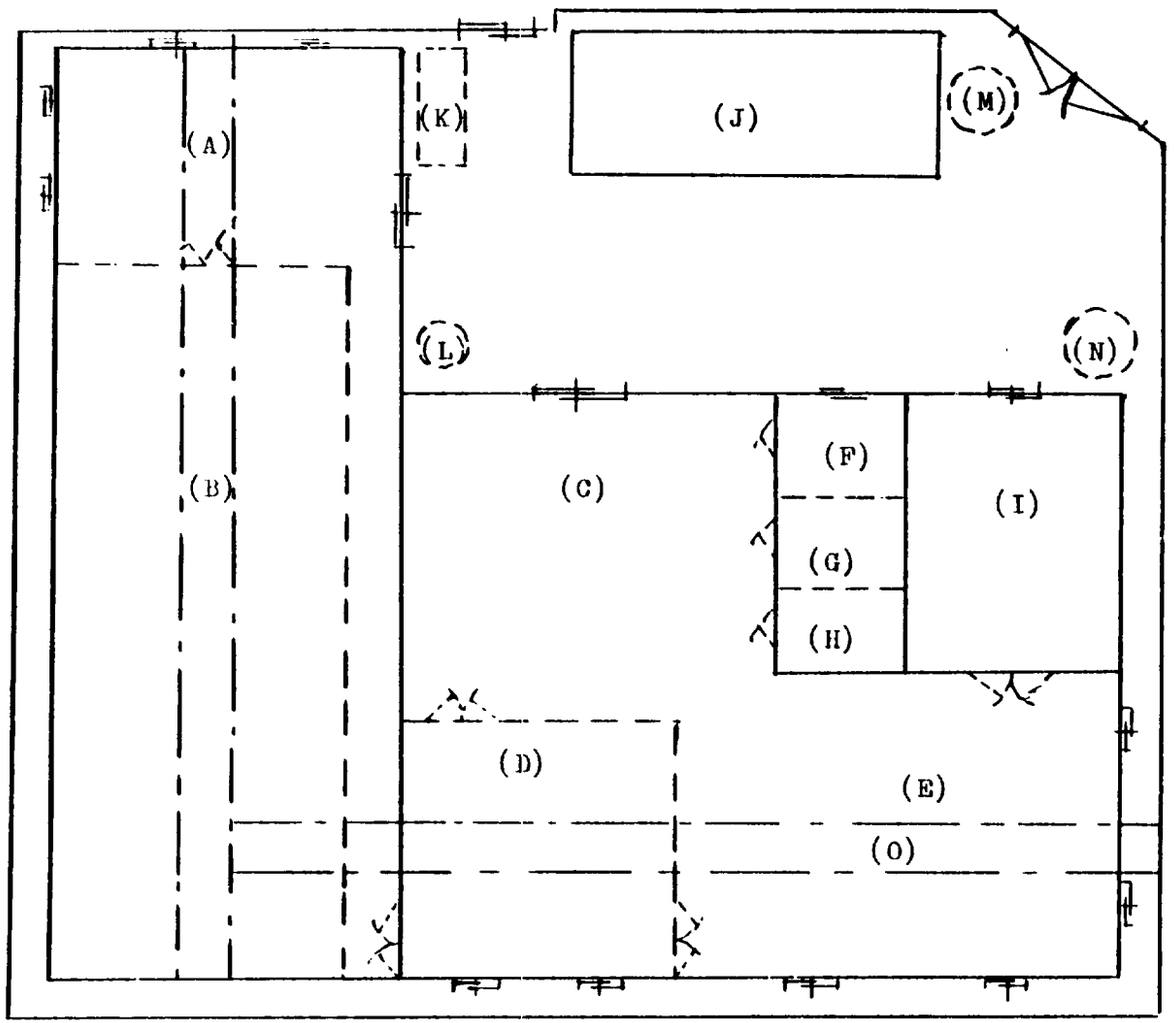
The only repair materials available in Viet Nam are bricks, mortar and timber; all the other items must be provided by the supplier of plant and machinery. These include:

Aluminium window frame	Cement
Steel frame	U-shaped drainage
Doors	Glass
Plywood	Wire and plastic mesh
	Paint

Conclusion

The proposed factory site is satisfactory generally speaking as a latex condom manufacturing site. Should the results of the well-water survey by the

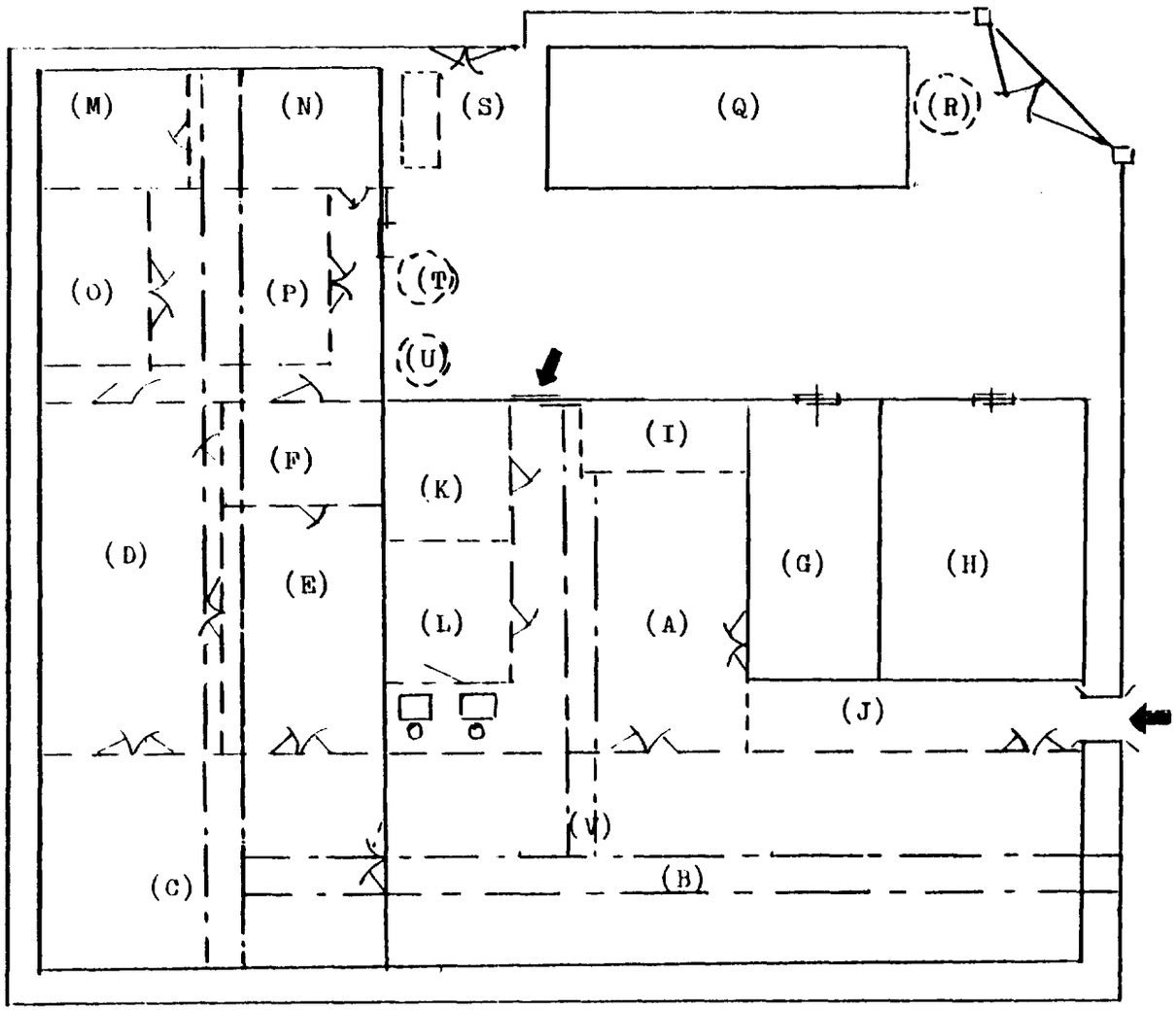
local geologist also be found to be satisfactory, the consultants recommend the site and building as a condom manufacturing factory. The necessary repair materials shall be provided by the plant suppliers and repairs should be effected by Vietnamese under the supervision of the suppliers (see figures III and IV).



(A) Compounding section
(B) Automatic moulding section
(C) Packing section
(D) Vulcanizing section
(E) Automatic testing section
(F) Workshop
(G) Boiler section
(H) Generator section
(I) Store-room
(J) Laboratory and office
(K) Electric substation
(L) Cooling tower
(M) Water tank
(N) Fuel tank
(O) U-shaped drainage

Scale:1/400

Figure III. Factory reconstruction plan



(A) Compounding section
(B) Automatic moulding section
(C) Vulcanizing section
(D) Automatic testing section
(E) Packing section
(F) Quality control section
(G) Store-room
(H) Laboratory
(I) Compounding materials room
(J) Raw latex store space (drums)
(K) Office (1)
(L) Office (2)
(M) Generator room
(N) Boiler room
(O) Spare parts room
(P) Work shop
(Q) Office (3)
(R) Water tank
(S) Electric substation
(T) Fuel tank
(U) Cooling tower
(V) U-shaped drainage

Figure 1V. Factory reconstruction plan in accordance with the requirements of the Government of Viet Nam

IV. PRODUCTION CAPACITY

The proposal by the Ministry of Health to produce 70 million pieces per year, when production is on a 24-hour basis is calculated on Viet Nam's actual needs as well as the desire to acquire a similar factory to that successfully operating in Malaysia.

Production efficiency is estimated at only 30% because Viet Nam's present electricity shortage allows factories to operate for only 16 hours each day. This also means a one-third loss of output, and losses due to starting and stopping problems, as well as making it difficult to produce high quality products under such conditions.

A total of 70 million pieces will only be reached when full electric power is available. Until then, production will be as follows:

$$70 \text{ million} \times 2/3 \times 30\% = 37.6 \text{ million pieces/year}$$

If this production rate causes shortages, bulk supplies may have to be imported, especially as there will be sufficient packaging capability. Meanwhile, the Government of Viet Nam should make every effort to ensure the plant operates the full 24 hours.

Electric power supply

The electricity supply in Hanoi and Ho Chi Minh City is as follows:

Hanoi	220 V, 50 Hz, and 110 V, 50 Hz
	380 V, 50 Hz, and 220 V, 50 Hz
Ho Chi Minh City	220 V, 50 Hz, and 110 V, 50 Hz

New establishments utilize 380 V, 50 Hz, and 220 V, 50 Hz. One reason for the supply shortage may be the lack of transformers.

The electricity supply system before the reunification of Viet Nam varied in method, type and according to area. As the supply capacity varies from place to place, information on each site is needed. The expected factory site in Ho Chi Minh City has a limited supply of 16 hours daily, and this has a large influence on condom production capacity.

Suspension

The suspension of the electricity supply occurs more frequently in areas where older equipment is used , often in the city centres. It also takes longer to restore supply in the centre of the city than in the industrial zones. As a result, these zones enjoy less frequent suspension of supplies. On an average, suspension occurs in Ho Chi Minh City twice each month and for about an hour each time. Not only is the manufacturing operation forced to stop during such times, but a loss of production is inevitable.

A similar loss of production occurs when operating for only 16 instead of 24 hours. From a productivity viewpoint, these losses are not negligible, and as the factory site is located in such an area, an electric generator will be required.

The Government of Viet Nam wishes to adopt power supplies consisting of 380 V, 50 Hz, and 220 V, 50 Hz, with input voltage of 6,000 V, 3-phase, 4-line system. This method is to be supplied for newly established factories in Ho Chi Minh City, and differing methods in other areas utilizing older equipment will be unified to the above system. However, due to the convenience of the plant-supplying country, electric input of the following system is also acceptable: input voltage 6,000 V transformer, 220 V, 110 V, 50 Hz, 3-phase, 3-line system.

Generator

To avoid low production efficiency when the electric supply is suspended, the capacity of the generator ought to provide the full electricity needs of the factory, but as this will be too large as well as expensive, the needs for the following equipment should be ensured:

Lighting fixtures
Boiler
Water supply apparatus
Cooling apparatus
Compounding equipment

The total power capcity needed for the above equipment is estimated at about 30% of the total requirements of the factory. To operate the generator, the Government of Viet Nam is willing to use steam power, but in this case

the boiler will be too large and uneconomical, and as the generator will also be too large, the consultants recommended a diesel engine generator utilizing light oil. This recommendation was accepted by the Government of Viet Nam.

Conclusion

The proposed electric input method is 6,000 V, 380 V, 50 H_2 and 220 V, 50 Hz.

The necessary electric power is estimated at 200-500 kWh, though it will largely depend on the characteristics of the plant to be supplied. The electricity capacity of an emergency generator will be sufficient to provide one third of total requirements in the factory.

In the processes involved in the moulding section of compounded latex, steam is utilized as heating power. The capacity of the boiler is in accordance with the characteristics of the plant to be supplied, but it would require evaporation at a rate of 400-1,200 kg/h. It is not necessary to use the boiler as a source of general heating in Ho Chi Minh, City. The Government of Viet Nam wishes to use coal as the fuel source, otherwise liquid fuels must be imported. However, coal poses the following problems:

(a) A large space is needed for storage, but there is no space at the present site;

(b) Complications arise in handling and management of coal stocks;

(c) Additional measures are required for smoke abatement and ash disposal is necessary.

For these reasons, the Ministry of Health has agreed to the use of a boiler operating on heavy oil.

A compact boiler is preferred and the consultants recommended a common safety-type water-tube boiler, fully automatic, and manufactured to the specifications of the plant and equipment suppliers.

No special regulations are at present in force in Viet Nam as far as air pollution by smoke is concerned; but the smog in Ho Chi Minh City is a product of motor cycle and car exhaust fumes, and as a result restrictions might come into force shortly.

Water supply equipment

Supplies of city water in Ho Chi Minh City are insufficient to operate a latex condom manufacturing plant, the suspension of water supply happens from time to time, and for these reasons the factory site should be located where abundant ground water is available. The depth of the well and the capacity of a large enough pump to obtain sufficient water should be agreed upon.

Although the necessary amount of water will differ according to the characteristics of the plant and production methods, it would require in the region of 10-20 tons/hour.

Therefore, it is essential to obtain a supply pump for this quantity of water and to place the water tank about 10 m above ground level in order to store the water and to obtain sufficient water pressure. The capacity of the tank will be determined in accordance with the ground water's pumping capacity. The Government also proposes an additional emergency tank beneath the factory building in case of suspension of the water supply. The capacity of this additional tank should contain a supply lasting 1-4 hours. There is only a little space at the present factory site and the Ministry of Health's technical expert wishes to install the tank beneath the warehouse. Waterproof cement, iron and other materials will be required whilst construction can be performed by Vietnamese workers. This matter should be reconsidered when a decision has been made with regard to the capacity of the supply tank. The following equipment is required:

Water supply pump
Well-water supply pump
Water tank and tower
Piping materials
Automatic controller for pump
Materials for constructing underground water tank
Materials to maintain temperature

Local engineers and workers

The following local staff are required for the repair of buildings, installation of plant and the maintenance of machinery:

Boiler man
Electrical wiring worker and electrical engineer
Steel-plate processing worker
Piping worker
Carpenter
Refrigeration worker
Painter
Civil engineering worker
Fireman
Glass worker
Machine worker

The level of trained workers is often not high enough in the case of large projects owing to the lack of experience; but the people in Viet Nam are diligent and capable, and with sufficient training could acquire the basic expertise. The main problem, perhaps, in repairing the building, the installation of plant and the trial period might be the difficulty of communication between supervising engineers from overseas and local staff because of the lack of interpretation. The project schedule should, therefore, take any work delay on this account into consideration.

Factory plant and equipment should be designed to operate smoothly and without complications, immediately after its arrival in Viet Nam.

Raw materials, energy and power

Consumption of raw materials, energy and power depend on the type and characteristics of the plant to be supplied, but in general, the range is as follows(based on 24-hour workday and producing 70 million pieces/year):

Natural rubber latex, 300-350 kg/day, 600-700 l/day[3/]
Compounding chemicals, 50-60 kg/day
Packing material (laminated tape), 16,000 m/day
Powder and other chemicals, 100-150 kg/day
Cleanser, 3-4 kg/day
Electrical power, 300-400 kWh
Water, 10-20 t/h
Steam, 300-1,000 kg/h
Fuel, 30-100 kg/h

3/ Measuring units in Viet Nam are length - metre, cm; weight - kg, g; quantity - litre.

V. KNOW-HOW AND SCOPE OF SUPPLY

The various problems involved and the difficulties encountered in the production of latex condoms have been outlined in this report; but to produce high quality condoms technical know-how is essential. Plant and machinery incorporating technical know-how is designed by the suppliers and each manufacturer has his own technical know-how, although it is not disclosed. Therefore, if the production of condoms were studied without taking into account this aspect, the plant's uselessness would become evident very soon. Know-how is disclosed only to the beneficiary after agreement with the United Nations and following a secrecy agreement between the Government of Viet Nam and the owner of such know-how. The main points involved are:

Specifications of natural rubber latex
Types, quality and quantity of compounding chemicals
Compounding techniques
Temperature control
Operating standards
Detailed drawing of plant and machinery
Instructions from technicians after trial operations

Without the know-how any factory will fail completely to achieve satisfactory productivity because of such phenomena as too many pin holes, stickiness, weakness or thickness etc. To overcome these problems and to satisfy not only the beneficiary but also the sponsor in all its aspects - United Nations - the selection of the project partner from those who have vast experience and possess the highest technology will be exceedingly important.

There is a large number of condom manufacturers but only a few of them manufacture to the highest quality. This in itself proves that without technical know-how, high quality condoms cannot be produced.

Production process

The process of manufacture of latex condoms, is shown in figure V (flow sheet). First, special high quality latex and compounding chemicals for vulcanizing, and dispersing agents and stabilizers which have been thoroughly crushed in a ball mill and homogenizer are mixed. The compounded latex is then stirred

COMPOUNDING PROCESS

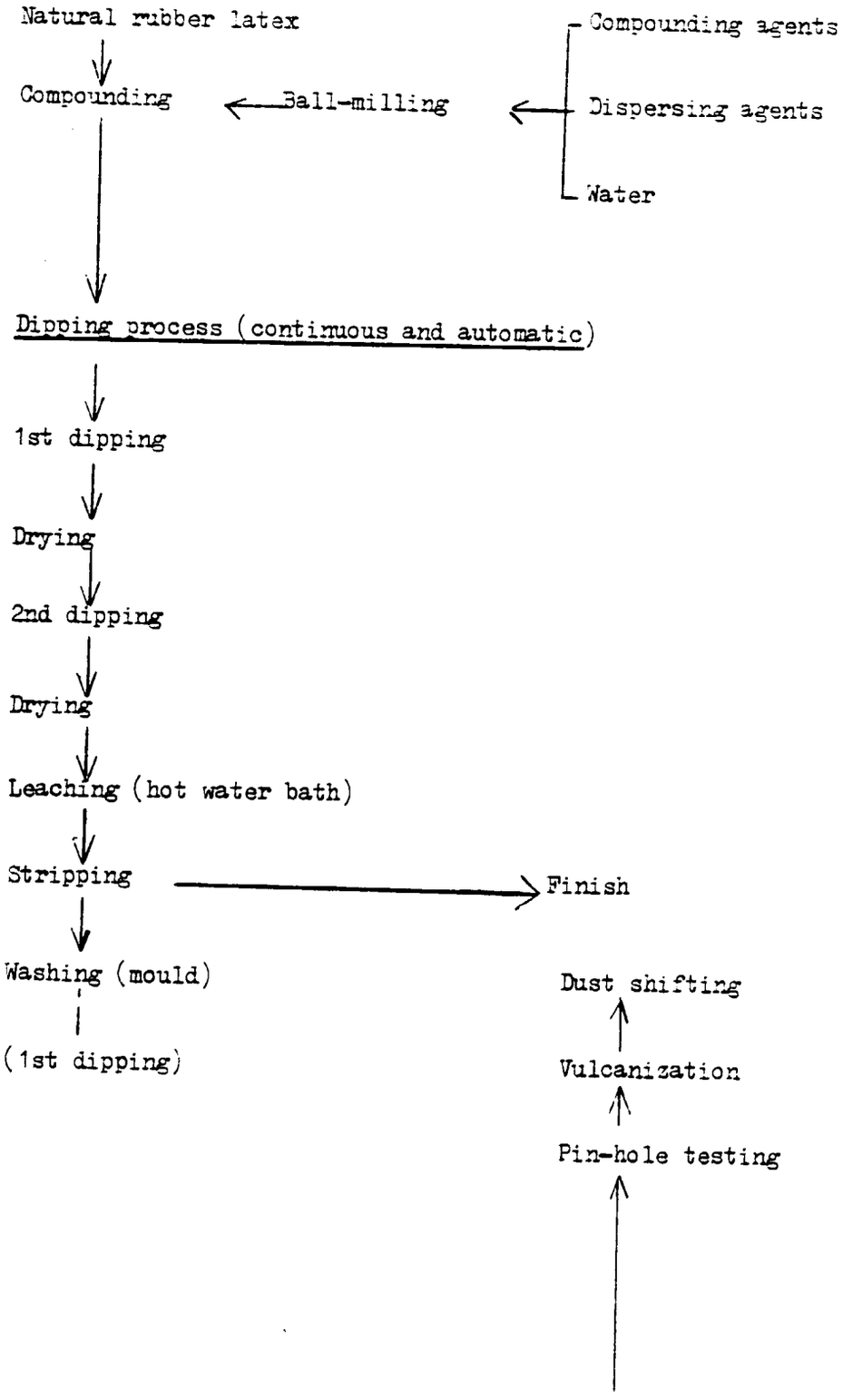


Figure V. Flow sheet of process for the manufacture of latex condoms

and heated in a vulcanizing tank. The process of vulcanization is all part of the technical know-how and the quality is vastly influenced as a consequence. The compounded and vulcanized latex is then passed on to the dipping tank of the moulding plant through the latex and supply tanks. These processes can be operated automatically.

Compounded latex is delivered into the dipping tank at a fixed temperature. The moulding of the condom's shape is made in the dipping tank when glass moulds fixed to an endless conveyor belt enter the tank. Temperature in the moulding section is automatically controlled.

The latex adheres to the glass moulds and is dried in a heated room, either by steam or electricity. This completes the stage of the manufacturing process for evenness and strength of the film.

The heated glass moulds are then dried in the cooling apparatus to make the film's thickness more even; dipping, drying and cooling are repeated twice

The edge of the moulded latex, now in the shape of a condom, is rolled with the necessary apparatus to form a rubber ring.

Latex film adhering to the mould is given the necessary chemical character and this step leads to the final process in the moulding plant involving the automatically controlled hot water bath.

The latex condoms are stripped automatically from their glass moulds.

After stripping, the condoms are cleansed, and to give them strength and elasticity, the final vulcanization is carried out with steam or electrical heating; any excess powder is then removed.

Testing and packaging

Each condom is tested for pinholes and appearance by being placed on to the metal mould of the electronic pin-hole testing machine.

It is then hermetically sealed in laminated tape for protection against deterioration, stickiness because of humidity etc. Packaging is made according to style and design of materials, and the condoms are then put into boxes in units of one dozen, one gross etc. A flow sheet for this process is shown in figure VI.

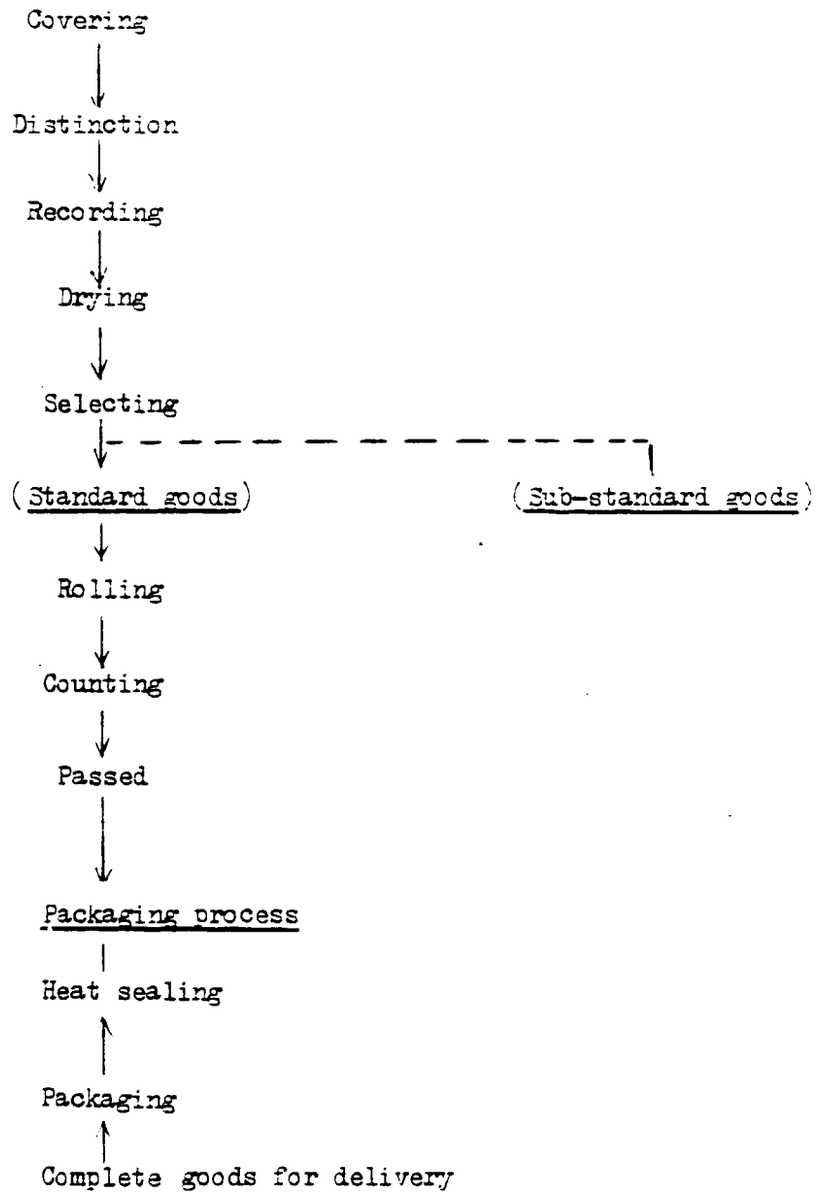


Figure VI. Pin-hole testing process

Building site

It is proposed that the factory site itself is prepared by the Government of Viet Nam. The present warehouse building should be utilized after the necessary repairs; all repair materials, except bricks and mortar, is to be supplied, and the work undertaken and completed by the Ministry of Health before delivery of plant equipment.

Details of repairs will be discussed with plant suppliers so as to comply with the requirements of a latex condom manufacturing plant. It is essential that sufficient and good quality ground water is available at the site.

The consultants did not anticipate any problems should it be found necessary to build a new factory 10 km from the present site.

Water supply equipment

A Vietnamese geologist must first complete an investigation of the available water and bores before any decision is taken on the final factory site.

All equipment - pumps, water tanks, controls, and supplementary piping materials - will be provided by the plant suppliers, as well as other necessary materials such as cement, iron, and steel.

The Vietnamese side will carry out all implementation works for the water supply, and in addition, will carry out the work for the large water storage tank.

Electricity supply equipment

The equipment required for the high-voltage electricity substation will be provided by the plant suppliers, in addition to the wiring for each section from the low-voltage receiver and receiving equipment.

Wiring to the substation and compliance formalities will be made by the Vietnamese technicians.

Boiler

The boiler, a chimney if necessary and all supplementary equipment will be supplied, but part of the installation work will be undertaken by the Vietnamese.

Generator

All the equipment is to be provided. Installation work requires the assistance of the Vietnamese.

Compounding equipment

All equipment is to be provided.

Foundations and building work will be carried out by the Vietnamese, although all the necessary materials will be supplied.

A latex storage tank will be required should the delivery of latex be effected by tank truck but if it is delivered in drums, it will not be needed. This should be decided after a decision is made on the source of the latex and the method of delivery from the refinery firm. However, it is preferred that delivery be in drums.

Installation of machinery up to the trial stage will be performed under the instruction and supervision of the plant suppliers.

Automatic moulding equipment

All machinery and equipment is to be supplied and installation work can be undertaken by suppliers.

Vulcanizing equipment

All equipment is to be supplied and installation work will be undertaken by suppliers. Foundations and building work will be carried out by Vietnamese with supplied materials.

Automatic electronic pin-hole testing machine

All machinery and equipment is to be supplied and work undertaken by the suppliers.

Packaging machine

A packaging machine to seal the condoms in laminated tape shall be supplied, as well as lubricating apparatus.

Testing machine (laboratory)

All testing equipment necessary for quality control during the production process and for checking the finished condoms will be supplied.

Not all testing equipment for the raw latex will be provided by the suppliers.

Laboratory equipment

Laboratory equipment is provided in two divisions. One is for the latex refining technology which will not be supplied by the condom manufacturers - the equipment will be provided on the advice of the latex refinery factory, and supplies should be arranged by the Government of Viet Nam.

After refining, all testing equipment for the raw materials will be provided by the plant suppliers.

Warehouse

All the necessary materials for the repairing of the factory will be supplied, but any special materials required for the repair of the warehouse will not be included.

Office equipment

Repair materials for the office building, and all equipment for the offices will be provided by the Vietnamese.

Most of the following items will be provided by the plant suppliers:

(a) Natural rubber latex - should imported latex be necessary for a period;

(b) Compounding chemicals - for a period of five years, on a six-month contract basis;

(c) Treating agents - for a period of five years on an annual contract basis;

(d) Packaging materials - laminated tape for heat sealing for a period of five years, but paper for boxes and plastic bags can be obtained locally by the Vietnamese.

Spares, delivery and maintenance etc.

The necessary spare parts for a period of five years, and the parts and tools for the installation and repair of plant and equipment will also be supplied.

Prompt delivery of plant and equipment must be made from the port without delay at customs.

All procedural formalities must be handled by the Ministry of Health within a scheduled time period.

Lighting fixtures, ventilator and cooling apparatus

All the necessary machinery and equipment relating to lighting fixtures, ventilator, and cooling apparatus will be supplied, but not for general purposes.

VI. WORKING CONDITIONS, ORGANIZATION AND TRAINING

Working hours

In order to maintain high productivity it is preferable that a latex condom manufacturing factory operates for 24 hours continuously, but because of the electricity shortages in Viet Nam only a 16-hour work day is possible at present. However, midnight working and the employment of women at night are allowed, although overtime for either men or women is not permitted.

Shift description

Compounding section - 8 hours from morning to evening by male workers

Moulding section - 24 hours (16 hours), three-shift basis by male workers

Electronic testing section - 16 hours (10 hours: one shift) two-shift operation by female workers with male supervisor

Packaging section - 8 hours regular operation by female workers

Laboratory testing - 8 hours regular work by female and male workers

Warehouse section - 8 hours regular work by male workers

Laboratory research section - 8 hours regular work by male technicians

Boiler - 24 hours (16 hours), three-shift basis by male workers, according to operating time of moulding plant

Work shop - 8 hours regular work by male technicians specialized in mechanical and electrical fields

Operational considerations

There is no heavy or dangerous work involved in the manufacture of latex condoms. To be borne in mind, however, is the fact that Vietnamese are not fast workers. Training for general workers and executives must emphasize this aspect and in turn this will have a large bearing on the maintenance of quality and high productivity.

Work shifts last for 8 hours with a 1 hour recess from Monday to Saturday each week, totalling 48 hours per week. Actual daily working time is 7 hours; Sunday is a holiday.

Excluding Sundays, workers have 5 days each year of national holidays and 10 days of paid vacation, but as the Government's slogan: "All for construction", is widely publicized, no summer or winter vacation is presently allowed.

Work days number 25-26 each month; the absentee rate is reported to be one day per month through illness, but regular monthly leave for women is not allowed. although women are permitted to perform light work at the time of their menstrual periods. Women generally work from 18-55 years and men from 18-60 years.

Lunch times can be flexible in order to operate machines continuously, an important factor in the manufacture of latex condoms. The custom has been for workers to go home for lunch, but today, people are tending to eat their lunch in the factory restaurants. It would be difficult to allocate such space in the present building, but if a new factory is built, space for a restaurant will be taken into consideration.

The present and proposed factory sites are located in Ho Chi Minh City, and bus and bicycle will be used by workers for transportation. The high unemployment rate in Ho Chi Minh City suggests that they would not require to travel from too great a distance, though capable managers and technicians must be employed regardless of where they lived. The slogan, "the right personnel to the right place", is well known in Viet Nam and no problem is foreseen in the employment of qualified personnel. Latex condom manufacturing does, however, require long experience, and young workers ought to be employed and be well trained. The consultants have formed the impression that this too will be no problem in Ho Chi Minh City.

Men and women in Viet Nam have equal pay, and there are seven levels of payments, the highest in the country being only four times that of the lowest.

The consultants conceded that the main problems as far as working conditions were concerned was that overtime was not permitted and the work period lasted for only 16 hours, inducing a loss at each operational time, and inevitably resulting in low producitivy with regard to quality and quantity.

Organization and staffing of condom manufacturing factory

An organizational chart of the condom manufacturing factory is shown in figure VII, and was prepared after taking into account the views of the Ministry of Health in Viet Nam.

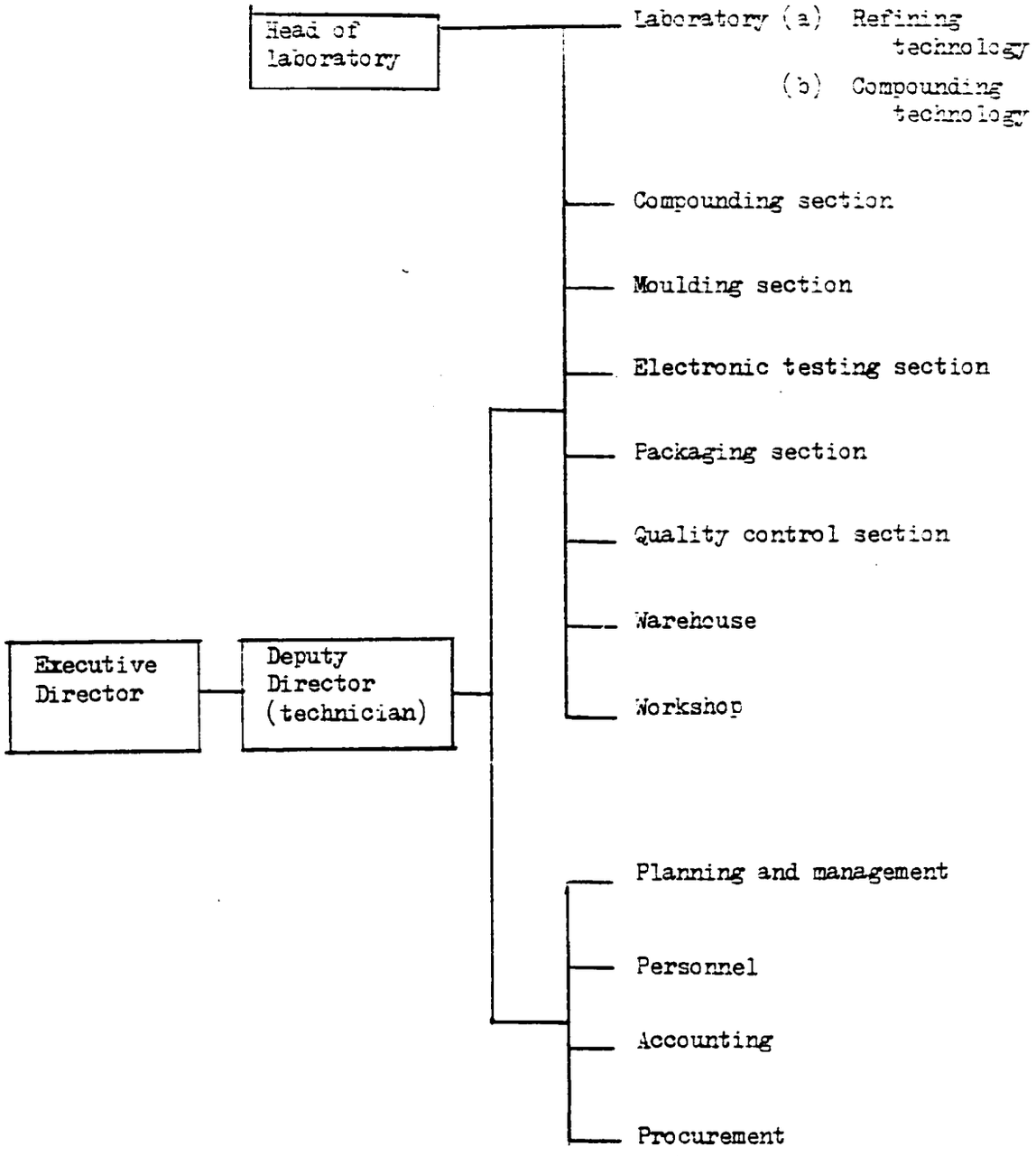


Figure VII. Organization chart of the condom manufacturing factory

Executive director

A high official from the Ministry of Health should be responsible for the management of the factory. He will have a deputy director who should be an expert technician. With the assistance of the deputy director and such divisions as planning and management, personnel, procurement, and accounting, the executive director should be able to run the factory in the most effective way to maintain high productivity.

Deputy director (chief engineer)

A university graduate is essential who is a qualified chief engineer. He should be responsible for the technical aspects of the factory and must have managerial talents in mechanical, electrical and chemical fields.

Head of laboratory

The minimum qualification is a university graduate with actual experience of latex technology as a professor or chief of research in a national institute for rubber. A knowledge of chemistry and botany are also required. He should be capable of controlling research workers and maintaining the laboratory. As latex refining technology is vitally important, the responsibilities of the head of laboratory should be equivalent to those of the executive director or deputy director.

Chief of compounding section

He should be able to supervise workers in the compounding section and to take part in meetings in the laboratory and to be able to develop the latest latex technology to maintain condom quality. Excellent chemical knowledge is required.

Chief of moulding section

An energetic and strong-willed person is needed as a member of the main production division to supervise male workers for two or three shifts. To maintain long production runs he must carefully watch the production process and be in a position to take immediate action in case an abnormal situation develops.

Chief of electronic testing section

In contrast to the moulding section, all workers in the electronic testing section are women. The chief of the section may also be a woman, but the question of her leadership ability may arise in the control of workers and in taking action to meet the demands of high-speed machinery. It would be advantageous if the person had qualifications in the electrical field.

Chief of packaging section

The leader and manager of female workers in this section is responsible for hermetically packaging condoms under sanitary conditions. A mechanical engineer is desirable.

Chief of quality control section

He is responsible for the quality and sample testing of condoms during the manufacturing process and at the finished stage. When defects emerge, immediate instructions must be given to the moulding and compounding section so that the necessary action may be taken.

Chief of warehouse

The responsible person must maintain a complete record of materials being stored in the warehouse, including chemicals, packaging materials, and bulk, semi-packed and finished products. He will also be responsible for the prompt delivery of finished goods in accordance with orders received from throughout the country.

Office manager

If sales efforts are not required, one chief might be sufficient to be able to control the office section; as an aide to the executive director he should be responsible for all aspects of planning, management, personnel, procurement, and accounting.

Job descriptions and training

Laboratory section

To study the available latex technology for the manufacture of condoms

Analysis

Trials of different compoundings

Resolution of chemical troubles in the manufacturing process

Testing of new raw materials and establishment of testing methods

Development and improvement of new technology

Testing of finished products

Inspection of delivered raw materials (in general)

Compounding section

Inspection of raw latex

Dispersing of compounding chemicals

Compounding works

Delivery of latex and chemicals

Control of chemicals to be used

Control of compounded latex

Ensure that raw materials conform to manufacturing suitability

Maintenance and control of machinery and equipment being used in compounding section

Moulding section

Operation of automatic moulding plant

Supply of compounded latex to moulding plant

Checking of dryers and control of drying conditions

Checking and control of rim rolling

Checking and control of stripping condition

Vulcanizing operation and control

Inspection of the moulding process

Cleaning of plant

Checking of mould-washing apparatus

Full control of automatic moulding (dipping) plant

Testing section

Bulk condoms to be placed separately on the moving metal moulds of the testing machine by female workers; training is needed to avoid misplacement on the mould

Operating electronic pin-hole testing machine
Maintenance and control of testing machine
Checking of rolling and counting mechanisms
Delivery of tested condoms
Control of condoms kept in the testing section

Packaging

Supply of lubricating oil to individual condoms
Packaging hermetically into laminated tape
Tape-packed condoms to be packed into boxes
Delivery of packed condoms
Control of bulk and semi-packed condoms kept in packaging section

Quality control section

Checking of glass moulds
Inspection of raw materials with co-operation of laboratory
Inspection of the manufacturing process
Inspection of semi-packed and finished products
Water-leakage test
Tensile strength and elongation at break tests
Bursting volume test
Electronic test
Aging test
Instructions to each section
Collection and analysis of data
Decision on each production lot
Development of new quality controls
Accomplishment of standardization
Inspection of stored products

Warehouse

Maintenance and control of raw materials
Maintenance and control of all condoms
Delivery and recording of condom stocks and various materials
Obtaining storage space

Workshop

Checking of plant and equipment
Repairs of damaged machinery and equipment
Periodic inspection of machinery, equipment and electrical parts
Improvement of machinery and equipment
Arrangements for supply of parts
Control of tools
Inspection of safety apparatus
Constant supply of electricity
Maintenance of generator
Periodic cleaning of transformer
Periodic exchange of electrical parts
Checking of consumption of electricity
Taking measures to save electricity
Constant supply of steam
Maintenance of safe operation of boiler
Maintenance and repair of piping in the factory
Taking measures to save steam energy in the factory
Maintenance of electrical and machinery equipment
Anti-pollution measures
Periodic cleaning of boiler
Co-operation with other sections

Training of Vietnamese staff and technicians

As this is the first experience of the Government of Viet Nam in establishing a latex condom manufacturing factory, full training is a prerequisite of the United Nations and the plant suppliers. Specialized education and training for the following staff will be necessary:

Executive director

This person is the most responsible individual in the management and supervision of the factory and should have complete knowledge of all aspects of the work.

Education and training with regard to general factory management should be given with United Nations assistance, and at least two months training by the plant suppliers shall be necessary.

Deputy Director (chief engineer)

Not only should he have engineering talents, but he must also be an excellent leader, giving proper instructions and taking adequate measures in a variety of situations. In addition, he should be fully conversant with the highest technology in manufacturing latex condoms. He is the most responsible person in the technical field. So many problems occur in the production of latex condoms, that he must be able to resolve each instance immediately, but with patience based on the hard efforts and co-operation of the staff technicians.

The selection of this person might decide the success or otherwise of the whole venture. After selection, education and training should take place with the plant suppliers for a period of at least three months.

Head of laboratory

The duties of this person are severe, because he might have to be responsible for the development of higher quality latex refining technology, and it is not known how long this will take in the present situation.

The Government of Viet Nam is considering planting new rubber trees on the rubber estate which the Ministry of Health expects to own. The head of the laboratory is asked to meet the specifications demanded for quality latex, and he should be able to co-operate with the deputy head and staff of the laboratory. He should have the opportunity of visiting Malaysia for 3-6 months to study the latest refining technology before installation of the plant. Training for this person should be undertaken separately from the plant suppliers.

Deputy head of laboratory

The deputy head should have similar training as the head of the laboratory.

Mechanical engineer

A specialist mechanical engineer is needed because a latex condom manufacturing plant is a large and precise operation. As for education and

training, it is considered that 3-6 months training will be sufficient at the time of assembling the machinery and equipment at the plant suppliers' factory up to trial operation in advance to shipment. He should then later be able to direct the Vietnamese workers at the time of installation.

Electrical engineer

An experienced specialist technician in the electrical field is also needed. Training should be given by the plant supplier in Viet Nam.

Chemical engineer

As latex condoms are manufactured mainly from natural rubber latex, a specialist chemical engineer is required. Latex variations must be studied in accordance with age of tree, tapping time, wet/dry season, defoliation and fruition periods. He should be able to resolve problems in relation to changes in water quality, compounding, vulcanization, drying, stripping etc. Training should be undertaken by the plant supplier in Viet Nam.

Training of section chiefs

Each chief of section should be qualified in his individual technique and be equipped with the leadership ability to ensure his fellow workers perform diligently. Training should be undertaken by the plant suppliers at the stage of machinery installation and again after the trial operation.

Training of specialists and workers

This training should be carried out by the chief of each section with the co-operation of responsible officials and plant suppliers.

Annex

LIST OF EQUIPMENT AND MATERIALS NEEDED

The consultants recommend the following list of equipment and materials for the construction and equipping of the latex condom manufacturing factory in Viet Nam. Unless otherwise stated, one set of each item is required in each instance.

For repair of building

- Cement
- Concrete blocks
- Doors and aluminium frames
- Glass windows and frames
- Iron frame
- Iron panels
- Lighting fixtures
- Plate glass
- Plywood panels
- Roof fan
- Steel plate
- U-type concrete blocks
- Waterproof mortar and cement
- Wood

Compounding equipment

Vulcanizing apparatus

Automatic temperature control type, with recording system and cooling apparatus - capacity, 800 litres/day

Ball mill

Made from ceramic and rotary type - capacity 400 litres

Colloid mill

Centrifuging type - capacity, 10-20 litres/min

Ionizing device

Ion-exchange type - capacity, 100 litres/h

Cooling apparatus

For latex charge

Cooling water tank

For latex control - capacity, 2,000 litres

Water pump

For latex control, 0.75 kW

Latex receiver

Capacity 20,000 litres

Air compressor

0.56 m^3/min. Pressure 10 kg/cm^2

Distilled water tank

Made of stainless steel - capacity, 200-300 litres

Measuring container and scale

5 litres, 1 litre, 50 kg, 20 kg, 5 kg

Other

Drum transporter, hoses, stainless steel mesh, latex supply tools

Automatic moulding machine

Capacity, more than 65 gross/h. It should have the following mechanism and be equipped with the following apparatus - driving, dipping, drying, rim rolling, stripping, powdering, electrical apparatus, hot water bath, glass moulds etc.

Automatic electronic pin-hole testing machine

Capacity, more than 100 gross/h. It should have the following mechanical apparatus - driving, testing, drying, rolling, counting, electrical apparatus, metal moulds, water tank etc.

Quality control testing instruments and equipment

Aging oven
Air compressor
Balance and scale
Bursting volume testing equipment
Dumbell cutter
Electronic testing equipment
Tensile tester
Thickness gauge
Water leakage tester

Boiler

Capacity, 1-2 ton/h. Water tube boiler - fuel: heavy oil. Oil tank, capacity 3 m^3. Water treatment apparatus for boiler

Electricity substation, transformer and receiver

Capacity, 200-400 kVA; 6,000 V, 220 V, 110 V, 50 Hz. Outside cubicle type.

Generator

Capacity, 100-150 kVA; diesel engine type. Oil tank, 400 litres. Water tank, 200 litres.

Equipment for water supply

Water pump 0.3 m^3/min
Overhead water tank, 10 m^3
Water charge tank, 250 m^3
Piping materials
Controlling equipment

Laboratory instruments

Air compressor
Balance
Beakers
Burettes
Cylinder
Densitometer
Desiccator
Dispersing balance
Erlenmeyer flasks
Filter papers
Glass moulds
Heated water tank
Oven
pH meter

Pipettes
Plastic beakers
Plate glass
Reagent
Refrigerator
Rubber roller
Small ball mill
Small vulcanizing apparatus
Stability tester
Stirrer
Stop watch
Stroboscope
Thermometers
Viscosimeter
Volumetric flasks
Water bath
Water distilling apparatus
Weighing bottles

Packaging machine

Capacity, 1,600 gross/8 h
Square-type heat sealer
Slender-type heat sealer
Lubricating apparatus

Equipment and tools for workshop

Air compressor
Anvil
Bench drill
Carpenter's tools
Chain block
Cleaning equipment
Electric welder
Electricity tester
Gas welder
Grinder
Hack-saw
Hand tools
Lathe
Measuring tools
Piping tools
Portable electric drill
Portable electric grinder
Stand-type electric drill
Surface plate
Tapping tools
Winch
Work table

Electric wiring materials

Electric wire
Electrical parts
Wiring tools

Piping materials

Pipes for water and steam

Piping parts

Piping tools

Spare parts (Special parts for plant machinery and equipment)

Bearings

Brushes

Driving parts

Electric heater

Electrical parts

Filters

Fuses

Gas medium for refrigerator

Glass moulds

Hoses and tubes

Oil and grease

Packing

Parts for boiler, generator and water supply equipment

Piping

Rubber and chains

Sponge sheets

Stainless-steel mesh

Various sheets

Raw materials

Natural rubber latex (six months' supply)

Compounding chemicals (five years' supply)

Automatic moulding plant

Cleanser, powder etc. (six months' supply)

Packaging machine

Lubrication oil and laminated tape (five years' supply)

Boiler

Treatment materials for boiler tube and water treatment materials (five years' supply)

Electrical appliances

Materials for electrical apparatus (five years' supply)

Materials for general use

Oil, grease etc. (five years' supply)

Testing operation for machinery and equipment

Test operation largely depends on time factors involving delivery dates, installation of machinery, supply of materials, manpower etc. But the testing is expected to go smoothly, as long as an adequate supply of high-quality latex is available. It may take some time, however, because of the need for the supplier's engineers and technicians to train local engineers and workers to the technical level needed. If low quality latex is utilized, the production of high quality condoms to the Japanese or Malaysian standards is impossible. Quality will vary, depending on the quality of the latex.