NOTES ON A VISIT TO INDO-CHINA

BY

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The writer visited Indo-China in April of this year and was privileged, by the courtesy of the directors and managers concerned, to visit many of the large rubber estates in that country. The object of these notes is to record some of the impressions obtained, paying particular attention to observations on estate factory equipment and operation.

General

The land in Southern Cochin China and Cambodia is flat or very gently undulating, and is free from the ravines and steep slopes so common in Malaya. It consists mainly of a light grey friable soil, and contains outcrops of red soil scattered like islands in it. The grey soil is of variable value but the red soil areas which are usually characterised by their great depth, are very fertile. The rubber estates of the big companies have naturally tended to become concentrated on the red soil. There seem to be no small-holdings of the type familiar in Malaya, owned and operated by Asiatics, but their place is taken by numbers of small estates which are usually owned by Europeans. These estates are operated by Asiatic managers and supervised in their spare time by the owners, who are frequently professional or business men. Such estates are naturally most numerous in the vicinity of Saigon.

The estates owned by the limited liability companies are organised in larger units than are common in Malaya. Five thousand acres is quite an average size to be served by a single factory, and there are several estates of more than twice this area. The reasons for this are firstly the flat terrain which renders the construction of roads easy, and thereby facilitates supervision of field work and transport of latex; and secondly the difficulty of obtaining an adequate water supply, which limits the choice of sites for estate factories. The country experiences a very pronounced seasonal variation in rainfall, and from November until April there is very little rain. Although this aggravates the difficulty of obtaining sufficient water, causes wide fluctuations in the yield of rubber, and introduces a grave risk of fire during the wintering season, it is not entirely a disadvantage. The complete absence of root disease in Indo-China is said to be largely owing to the dry periods.

An ample supply of Annamite and Tonkinese labour is available in the country. Both free and contract systems are used. In the former system the labourers are employed by the day from neighbouring villages and the estate takes no responsibility for housing them or providing medical attention. The contract labourers are drawn from the northern parts of the country, and are housed on the estates in villages of huts similar to the new cottage-type lines which are being built in Malaya. In addition to the wages the estate provides a rice ration, medical attention, and a contribution to the provident fund which is controlled by the Government. The total cost to the estate is about 40 to 45 piastre cents per day. At the present rate of exchange (*circa* 170 francs, *i.e.* 17 piastres, to £1 sterling) this is about half the cost of labour in Malaya.

The planting industry in Indo-China is of fairly recent development. The planted area has increased from 85,000 acres in 1925 to approximately 315,000 acres now. Most of this development took place between 1926 and 1932, by which time the industries in Malaya and the Dutch East Indies were well established and had carried out a considerable amount of research. Full use was made in Indo-China of the experience gained in other countries, as is shewn by the fact that one-third of the total area is budded with the best material that was available in 1930 to 1932. This factor, together with the rich soil, absence of root disease, organisation in large units, which require the minimum of supervision, cheap labour, and favourable rate of exchange, places Indo-China in a very strong position as a rubber-producing country. A good general account of The Rubber Plantation Industry in French Indo-China, by W. G. Birnie appeared in the *Bulletin* of the Rubber Growers' Association for June 1938. [**20** (1938) 239].

Factory Practice

Latex is usually transported by lorry. Transportation tanks which can be pushed on and off the lorry are in common use. The majority of these are of sheet steel though aluminium is coming into use. In some cases large steel tanks which are built on to the lorry or to a trailer are seen. In spite of the large areas served and the large volumes of latex handled, the latex is usually all in the factory by early afternoon. Anti-coagulants are regularly employed. Sodium sulphite is used in some cases. One group of large estates uses ammonia solution which is prepared by a distillation process from ammonium sulphate on the estates. Another group has evolved an anti-coagulant mixture containing sodium sulphite, with small added amounts of caustic soda and para-nitrophenol. This is said to be as effective as sodium sulphite alone and more economical in use.

Factory Design and Lay-out

As stated above, the factories are usually designed to handle a large crop per day. Five to ten tons of rubber per day is considered quite normal, and one factory capable of making forty tons per day was visited. A straight-line production system is used. The latex is received in bulking tanks at one end of the factory and is usually delivered to fixed rows of coagulating tanks set at right angles to coagulum chutes which run the length of the factory to the sheeting batteries at the far end. Continuous sheeting is invariably used on the large estates. The rubber is cut and hung on to smoke-house trucks, which pass through smoke-houses generally of the tunnel type to the packing shed. The " tanks-on-trucks " system has recently been installed in one or two of the smaller factories where only one sheeting battery is required. Wide use is made of reinforced concrete in constructing the buildings. Standard sections are available for roof trusses, rafters etc. in this material. Good local bricks are also available and are widely used. Steel-frame or timber-frame buildings are less common.

Bulking Tanks

Large concrete bulking tanks lined with white tiles are in general use and appeared to be well liked. Many of them are built in two compartments, the smaller one into which the latex is discharged from the lorries, being separated from the bulking chamber proper by vertical gauze screens which serve as the initial strainers. The latex in nearly all cases is sieved again after dilution and settling. A few new rectangular aluminium bulking tanks of 3,000 litres capacity are in use. They employ a swivelling pipe inside each tank pivotted at the outlet near the base, with the free open end arranged to float just below the surface of the latex. By this means latex may be continuously withdrawn from the upper layers and the risk of disturbing the sludge during run-off is reduced to a minimum.

Filters

Several novel types of filters are used for straining the latex during transit from the bulking tanks to the coagulating tanks. Perforated aluminium sheet is popular in place of gauze as a filtering medium. One filter consists of an aluminium cylindrical vessel containing concentric cylinders of filter plates, with the coarser ones inside. Latex enters at the centre of the base, flows outwards through the increasingly fine filter plates, and is drawn off from the side of the container. The filter cylinders can be withdrawn easily, for cleaning, and the apparatus is provided with a cover which enables it to be used under pressure.

In a second type perforated aluminium sheet is made into a sleeve about six inches in diameter by thirty inches long, closed at one end, and secured at the other by means of a bayonet fitting to a swivelling tee through which it is connected to the outlet cock. The latex from the bulking tanks is delivered into a trough in which several of these sleeves rest horizontally. The latex passes through the perforations and flows through the swinging joint to the outlet cock, and thence to the coagulating tanks. When the filter starts to clog the sleeve may be lifted into the vertical position, about the swivelling joint; the perforations are thus lifted above the liquid level, and flow ceases. The sleeve can then be removed for cleaning, and replaced. This device has been developed and patented by Mr. A. Denholm of the Société Indochinoise de Matérial Méchanique.

Another novel filter is made in the form of a hexagonal drum, each face of which consists of a readily-detachable perforated plate. The drum is mounted horizontally in two trunnions in a small tank into which latex is fed through a ball valve, so adjusted that the drum is immersed for about three-quarters of its depth. The liquid passes through the perforations into the drum, from which it flows *via* the hollow trunnion to a pipe which conveys it to the coagulating tanks. While the filter is in use it is occasionally rotated by hand to bring one of the clogged faces to the top, clear of the liquid. The plate can then be removed for cleaning, and replaced without interrupting the flow of latex. This device was developed by the Société Indochinoise des Plantations Réunies de Mimot and has been patented by that company.

Coagulating Tanks

Aluminium tanks designed for making continuous coagulum are used. They are constructed of sheet metal secured in steel or cast aluminium frames and no timber is employed in the structure. The sides and bottoms are smooth, and a separate frame which rests on top of the tank is slotted to hold the partitions. These are located at their lower edges by slotted beadings or combs, which are not attached to the tank but are held in place by hooks passing up between the plates and secured at the top by wing nuts. The separate frame carrying all the partitions can be raised or lowered at will, by a hand winch, or an electric crane. The normal working procedure is to assemble the partitions in position in the clean, empty tank. The frame carrying the partitions is then hoisted and the lower beadings securing the partitions are fixed in place. When the latex and acid have been mixed in the tank, the partition assembly is lowered rapidly into place, the hooks securing the beadings are withdrawn and the tank is left overnight. Next morning the partitions are usually removed by hand, leaving the frame in place on the top of the tank, and the beadings resting on the bottom. All the partitions can be lifted out at once by hoisting the frame, but this may cause some tearing of coagulum, and presents no advantage, since no satisfactory method has yet been found for cleaning the partitions without removing them from the frame. This system therefore offers no advantage over the Malayan one during machining, but it saves considerable time in placing the partitions in the latex during coagulation. This is particularly important in factories where a large number of tanks must be coagulated before the latex deteriorates.

The standard tanks are 3 metres long, by 1.1 metres wide by 45 centimetres deep and contain 99 partitions, thus giving 200 sheets. With coagulation at 16 per cent dry-rubber-content each tank will yield about 425 lb. of dry rubber. The coagulum is wide and is only about $1\frac{1}{8}$ inches thick. This use of thin wide coagulum facilitates machining and plays a large part in securing the high battery outputs which are obtained in Indo-China. It also renders unnecessary the rather complicated corrugations in the sides of the coagulating tanks familiar in Malaya, which are used to avoid the thick patches formed in continuous sheet at points where the coagulum passes round the ends of the partitions. Coagulation is usually carried out at higher dry-rubber-contents than are used in Malaya. The standard of one group is 16 per cent and others work up to 18 or 20 per cent dry-rubber-content.

Tanks identical in size with the standard tank but containing 109 partitions are used in some places, and on one large estate tanks 5 metres long were observed. On another estate there are three tanks each 150 feet long set lengthwise in the factory with the bulking tanks at one end, and a sheeting battery for each tank at the other end. Each tank is divided into ten sections by means of fixed partitions. Two of the tanks have inlets in the base of each section and latex enters from below, through an aluminium pipe connected to the filter. This minimises the formation of froth. In the third tank the fixed partitions are cut away to form weirs, and when latex is admitted it fills the first section, overflows to the second, and so on, until the whole tank is filled. Slats are then fitted over the weirs, the latex in each section in turn is mixed with acid, and the partition assembly for the section is lowered into place by an overhead travelling electric crane.

The tanks are provided with a 3-inch lip which allows them to be flooded, and the coagulum from one section can be floated down to the machine, over the top of the other sections.

Coagulating Equipment

Where the standard tanks are in use flooding is not normally adopted. A central coagulum chute full of water is used to float down the coagulum but there is, in most cases, a gap between the ends of the tanks and this chute, bridged by a small portable chute section, which is used to transfer the coagulum from the tank to the main chute. In large factories the latter is usually wide enough to carry two ribbons of coagulum side by side, and is divided at the end to feed two sheeting batteries simultaneously.

In one case an acid tank is arranged on rails over the central chute so that it can be pushed opposite each tank in turn, and the measured quantity of dilute acid delivered directly into the acid distributor resting on the coagulating tank. This distributor consists of an aluminium tube the length of the tank, with a narrow longitudinal slot in it. The tube is pivoted at each end in a small block which rests on the edge of the tank. The tube is filled with acid through an inlet hole while the slot is at the top, the inlet is then closed, and the tube is rotated to bring the slot to the bottom. The acid then falls as a thin sheet along the length of the tank. While the acid is running in, the tube is caused to traverse the width of the tank by sliding the mounting blocks along its edges. This gives an excellent distribution of acid. A novel type of mixer is used. This consist of an aluminium sheet almost the full width and depth of the tank, in which I shaped cuts are made, the two tongues so formed being bent out from the plane of the sheet in opposite directions to an angle of 45°. A stiffening bar with a handle at each end is fixed along the top edge of the sheet and carries rollers which run along the edge of the tank. This mixer is pushed to and fro along the tank by two labourers. It is very efficient and three or four passes are sufficient for satisfactory mixing.

Sheeting Batteries

A number of the Huttenbach sheeting batteries, of the type well-known in Malaya are used. Most of these machines have been altered, by shortening the main frame and the driving shafts, and bringing the pairs of rollers closer together. This modification is said to give more efficient working. Sheeting batteries produced by two Saigon firms are also widely used. One of them, Société Indochinoise de Matérial Méchanique, manufactures machines having four or five pairs of smooth rollers and a pair of marking rollers, all set close together and driven by chains in the conventional way. The other, J. Cairns & Co., also makes machines having five and six pairs of rollers again set close together but uses the flat-faced type patented by Reginato for the first two pairs. These machines are all designed for working with continuous coagulum, and are very well made and efficient. In many of them the rollers are mounted in ball bearings and special devices are incorporated for the fine adjustment of the roll nips. In all cases the batteries are driven by electric motors, and a variable speed device is incorporated in many of the drives so that the speed of the battery can readily be adjusted to suit the conditions. The standard rollers are six inches in diameter by twenty-six inches long, and bronze mantled marking rollers are used in all cases. It was noticed that there is a comparatively small increase in the width of the coagulum during machining. This is probably owing to the fact that the coagulum entering the machine is thin, and that the machines are always set to keep the coagulum under slight tension during its passage between the rollers. At the end of the dry season when these observations were made most factories were operating on comparatively small crops and the machines were set for a "comfortable working speed" rather than for peak outputs. Under these conditions it was estimated that the average output was about 2,500 lb. dry rubber per machine per hour. In one observed test an output rate of 3,660 lb. dry rubber per hour was recorded on a full tank coagulated at 16 per cent dry-rubber-content, and it was claimed that over 4,000 lb. per hour can be achieved by increasing the battery speed. The sheet is one-eighth of an inch thick and free from machine faults. The roll speeds are not very much higher than those used in Malaya, and the higher outputs are due largely to the difference in the coagulum, the use of continuous sheet, and care in setting the machines and training the labour force.

An agency for the Guthrie Automatic Sheeting Batteries was established in Saigon early this year but no figures are available for the performance of these machines in conjunction with the tanks used in Indo-China. J. Cairns and Co. have recently placed on the market a four-roll automatic machine designed to handle either continuous coagulum or separate sheets. The machine comprises three pairs of flat-faced rollers and a pair of bronze markers mounted on a steel frame which slopes slightly from the feed end to the markers. The frame is very carefully filed true so that the bearing housings are mounted perfectly squarely. Ball bearings are used with a well-designed chain drive which runs in an oil bath and requires only a pint of oil to keep it lubricated. The whole machine when assembled is only one metre long and can be rotated by a single finger on the clutch. Provision is made for the fine adjustment of the nip of each pair of rollers and the chutes are of polished stainless steel. This machine is stated to be capable of rolling 3,000 lb. of continuous sheet per hour, and has also been tested on separate sheets of coagulum one-and-a-half inches thick, which it handles satisfactorily.

Washing and Cutting

One of the main difficulties in working with continuous sheet is that of dealing with the long ribbon of machined rubber issuing from the marker, and arranging a method of cutting and hanging which will keep pace with the output. This problem has been solved in Indo-China. The continuous strip of machined sheet passes through a washing machine consisting of two hollow aluminium rollers mounted so that they can rotate freely in a frame of iron pipe. The sheet passes under the first roller and up over the second one. Horizontal perforated water pipes are mounted between the two rollers so that the sheet is sprayed

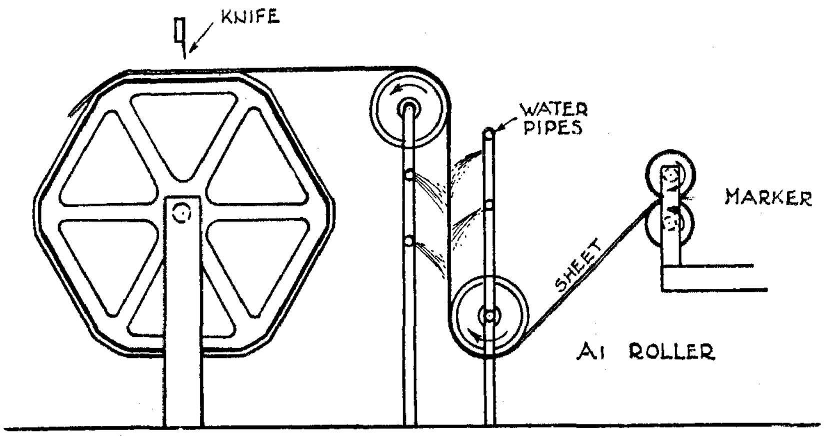

Fig. I

vigorously on both sides with clean water, as it passes through. From the upper roller the sheet passes on to a hexagonal drum which is free to rotate about a horizontal axis. The labourer who cuts the sheet, rotates this drum by hand, and a second man picks off the cut pieces and hangs them on a *berotie* in an adjacent rack. Two more labourers are employed to transfer the filled *beroties* to the smoke-house truck and place the empty ones in position near the end of the machine. The washing and cutting devices are illustrated in Figure I. Both are cheap and simple to construct. The cutting drum consist of two end castings of aluminium or iron secured to a shaft which is carried in bearings supported by short stanchions. The faces of the drum are of hard wood.

Power Supply

The sheeting batteries on the large estates are all driven by electric motors. Each estate is equipped with its own central power station containing Diesel-generator sets. In many cases these are very large. The usual arrangement is to use a large Diesel engine which is coupled directly to the driving shaft for the crepe battery and to drive a dynamo from this shaft. A small stand-by generating set is used when the crepe machines are not working. Care is always taken to ensure that there shall be an emergency supply if the main source of power breaks down. Electric motors and in fact all items of equipment are standardised as far as is possible throughout a group, so that a limited supply of stores and spares will suffice for the whole group.

Drying

Drying and smoking are usually carried out in three or four days in smoke-houses of the tunnel type. On one group two tunnels are employed, in each of which the rubber remains for two days. The furnaces are at the side of the building, far below ground level, and the flues are parallel to the rails. A more recent type is designed for drying in three days—one day in the first building, which is well ventilated and has provision for draining off dripped water, and two days in a second building. Both buildings are of the tunnel type, with the flues parallel to the rails. The roof is continued between the two houses and the furnaces are accommodated below the rails in this space.

On another group which consists mainly of very large estates, three blocks of tunnels are used. The first two, which are for the first and second days' drying respectively, are heated by wood fires at each end. Each flue and pair of furnaces serves two tunnels. The third block is heated by steam, and in times of high output completes the drying in three days, but it is preferred to reduce the temperature and leave the rubber in this block for two days when space permits. One estate is using enlarged Subur-type smoke-houses, which hold four trucks each carrying 1,600 lb. of rubber in each chamber. Two furnaces are used for each building and the conventional flue system is duplicated. As in Malaya, difficulty is experienced with water dripped from the sheets after they enter the smoke-house, and in most cases provision for drainage is made. On one estate it has been found that by heating the rubber vigorously at first this dripping can be completed in an hour. A large smoke-house has therefore been designed in which the rubber can be dried in four days in a single building. Steam-heating is used and supplementary wood fires provide the smoke. Provision is made for close control of both temperature and ventilation, and for the rapid removal of water. The wet sheet is strongly heated with little ventilation for the short while until dripping ceases, the temperature and ventilation are then adjusted and drying proceeds in the normal way.

All the smoke-houses referred to are very well built of brick and reinforced concrete, and in many cases double brick walls containing cavities filled with charcoal are used. The large sizes and the expensive type of construction used are likely to prevent these designs from becoming of practical interest in Malaya.

Dry Rubber and Packing

Most of the finished sheet inspected was of good No. 1 quality.

The sheet is usually a little thicker and heavier than Malayan rubber and is smoked to a light medium colour. In some cases it seemed slightly tacky, and this can be ascribed in part to several causes, including the presence of large proportions of rubber from young budded trees, the free use of anti-coagulants, rapid drying, and, in some cases, very little washing. If washing is reduced to a minimum serum-solids remain in the rubber and a slight increase in the weight of the dry crop is achieved. Some estates find it possible to do this without incurring the defects of rust, mould etc. usually associated with inadequately washed sheet.

The majority of estates in Indo-China, including even the very large ones, carry out their packing with the aid of only one or two hand-operated presses. Instead of a special structure built on the press to support the cases during compression, separate boxes are used. These strong boxes have hinged sides and detachable tops, and are mounted on small castors. An empty plywood case is placed in one of these boxes and the sides are closed by hasps and pegs. The case is filled, and the lid of the strong box is placed on top of the rubber. The box is wheeled under the press and compressed until the lid can be secured down by its hasps and pegs. The press can now be opened and is ready to receive a second charge while the recently-compressed rubber is kept under pressure in the strong box for fifteen to thirty minutes. The pegs can then be knocked out and the case is ready for nailing and marking. These boxes not only allow each press to deal with a much larger quantity of rubber, but also provide a ready means of transporting the cases to and from the press.

CREPE MANUFACTURE

Nearly all the large estates are equipped with crepe-making machinery and many grades of this product are made, though the bulk of the work is in making off-quality rubber. The quantities of scrap are sufficiently large to make careful grading worth while and pale crepes of high quality are produced from clean cup lump, pre-coagulated latex, etc. Most of the newer installations consist of batteries of five machines having rolls sixteen inches in diameter and thirty-two inches long. The amount of machining given depends upon the grade being produced, but a typical example is five times through the first machine, four through the second, two through the third, and once each through the fourth and fifth machines.

CREPE DRYING

Single-storeyed buildings are used and artificial heating is employed in conjunction with electric fans for air circulation. Heat is supplied either by steam or hot water pipes. Most of the drying sheds are very simple in design and are very effective, but would be of no interest in Malaya where steam and electric power are not usually available on the estates.

Conclusion

The visitor from Malaya cannot fail to be impressed by the fine layout and lavish equipment of most of the estate factories in Indo-China or to feel that in some ways they appear to have surpassed Malaya. A closer inspection reveals that the apparent superiority is due to the inherently different conditions in the two countries, and some of the apparent improvements could not be economically applied in Malaya. The differences are mainly due to the larger crops handled in each factory, the recent growth of the industry, and the currency in Indo-China. The centralisation of factory work could not be carried out to the same extent in Malaya as is possible in Indo-China, owing to the more difficult terrain. Existing serviceable machinery cannot be scrapped and replaced out of hand unless the saving in production costs will be large. The currency is a very important factor and one over which the rubber producer has no control. The present rate of exchange is very approximately two piastres per dollar, but the purchasing power of the piastre in Indo-China remains almost equal to that of the dollar in Malaya.

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Société Indochinoise de Matérial Méchanique

Messrs. J. Cairns & Co.

Messrs. Diethelm & Co.

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