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VIET NAM

Technical report: The present situation of Vietnamese canning industry and can-making facilities*

Prepared for the Government of Viet Nam
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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ABSTRACT

Establishing a laboratory for improved sanitary can coatings and sealing compounds.

DP/VIE/80/033

Purpose of project : To make a survey on the canning industry in VIET NAM.

At present, many types of canned fruit have been made mainly for export purpose. The cans used for packing of these products are made without any quality control in small can-making shops. Corrosion protection of packaging materials (tinplate, lacquered tinplate, etc.) is not satisfactory.

In the report, some suggestions are prepared to establish a suitable lacquering line, a central can lid-making shop, a laboratory for quality control and there are some requirements for quality control concerning raw materials and seaming of cans.

INTRODUCTION

Demand for canned products has been growing rapidly mainly for export purposes. The cans made of unlacquered tinplate have not been suitable for the packing of food products. These so-called "sanitary cans" have been mostly made by hand. Last year, a UNIDO expert stated that the can quality and quality control were not satisfactory. That statement could be confirmed on my visit to Vietnamese canning factories, including can-making shops. The unsatisfactory quality of cans limits the export earnings and reduces the profit of canned food export activity. Therefore, the Ministry of Food Industry decided to develop the can-making and tinplate lacquering.

The object of my mission is to review the canning industry in Viet Nam to assess its present and projected future requirements and, in particular, varnishing, can-making and quality control operations in canning factories.

I consulted experts in the Ministry of Food Industry on existing and projected demand for cans and some factories were visited. Demand for cans in quantity and quality respects, on the basis of experience, was examined. The quality requirements and testing of tinplate and cans for the food industry are determined on this basis according to the international practices and standards.

RECOMMENDATIONS

(1) The standards and quality requirements for sanitary cans have to be elaborated and put into practice in the canning factories.

(2) A taking over of imported tinplate, according to quality specifications described in Appendix 1, has to be initiated.

(3) To establish a central lid-making (for cans) shop in the My Chau Canning Factory, located in Ho Chi Minh City.

(4) To establish a laboratory for testing of raw materials used by lacquering and the other can-making shops, and testing and inspecting of can-making activities.

(5) To establish a workshop for preventive maintenance and repair for the lacquering line and lid-making equipment.

(6) To establish a tinplate lacquering line in My Chau Canning Factory which has a capacity of app. 11 million sheets/year.

(7) The Ministry of Food Industry should have a comprehensive study for other packing of foodstuffs composed (jars, non-rigid container, etc.).

(8) Before beginning investment, it is essential for decision makers and project managers to get acquainted with the lacquering and can-making processes applied abroad. Later, some specialists from the canning industry have to study this profession in some existing and well-equipped factories abroad. They should be trained for the most essential operations, those such as running and maintenance of machines, quality control, etc.

(9) Skilled experts should be employed to take part in designing, realization and putting into operation of the project.

(10) In the canning factories, other quality and hygienic activities have to be increased.

(11) In the near future, having obtained experience in the central lid-making, a central can-making shop could be established on the basis of existing BLISS machines supplying the cans for canning factories located in Ho Chi Minh City. They would have these machines repaired by manufacturers.

1. The Status of the Canning Industry in Viet Nam

In the country, fourteen factories deal with canning activities. Three of them belong directly to the Provincial Committee, the others belong to the Ministry of Food Industry. There are two so-called Canning Enterprise Unions, one of them is active in North Viet Nam, the other in the South. The list of factories is indicated in Appendix 7.

The annual (1985) production of canning factories is in the range of 27,500 Tons of canned food products (detailed in Appendix 8).

At present, the main products made are :

- pineapple slices, chunks in syrup
- rambuta (tyom-tyom) and lychees in syrup
- mango and banana nectar
- some organge and lemon juice, jam and marmalade
- some pickled cucumbers
- salted peanuts vacuum packed.

Note: the quantity of meat and other vegetable products could be neglected.

Manual labour is characteristic of the visited factories. The preparation of raw materials (peeling, cleaning, soaking) is made by hand. Only for peeling of pineapple is a hand-fed machine used.

Chunks and other types of dices are also made by hand; a machine is used only in the case of making pineapple slices. Filling of solid and liquid parts of products is done manually. Factories have many types of closing machines to seam the filled cans. There are some Angelus, Lubeca , Metal Box Tanico, Bulgarian and Russian equipment. These are mainly semi-automatic seamers but some of them are automatic ones.

Pasteurization is carried out in baths(sometimes made of brick !), where the temperature control is not satisfactory. One-stage evaporation, equipped with semi-borometric condenser, is used for concentrates of juice.

This equipment came mainly from Poland.

In my opinion, one of the biggest technological insufficiencies is that they are not using exhaustive technological methods. The presence of oxygen in the canned food could result in many problems, for instance : net weight decrease, fruit decolouration, decrease of Vitamin C content, etc.

Each factory has its own laboratory, but they are very poorly equipped with instruments. Laboratories have no Ph-meter, heat penetration register, quality control instruments of seaming of cans, etc.

At least some notes concerning the Canning Research Institute in Hanoi : It was set up in 1972 and its assignment is the following :

- to prepare new technological processes
- to develop new canned food
- to deal with packaging problems in canning industry (tinplate, jars, plastic, etc.)
- to help state farms and cooperatives to select new varieties of vegetables and fruits for industrial purposes
- to develop canned meat processes.

There are 30 employees -- among them, 22 high school graduates. They also have few instruments and, therefore, their activity is determined by this fact.

2. Present status of sanitary can-making

Canning factories have been making cans generally for own consumption. Except two factories the others have the following typical can-making facilities :

(a) Body making :

- Slitter slits the sheets into body widths and slits the widths into body heights.
- Stamping machine removes four edges of body.
- Small-diameter rollers perform round shape of body.
- Stamping machine forms hooks at about 90^{c} down to two edges where the side seam will ultimately be made.
- Stamping machine hammers the hooks flat .
- Side seaming is made by hand.
- Flanger is a multihead equipment where both ends are flared out to form flange.
- Double seamer where one end is applied and sealed to the body.

(b) Lid (end)-production :

- Shear cuts strips from tinplate sheets for stamping lids.
- Press mainly with one die stamps and preforms the lids. The strips are hand fed to the press.
- Curler completes the metal-forming of end production. The curl forms to containment for lining compound. Curler gives a suitable starting profile for double seaming.
- Lining machine sprays solvent-based compound (at present it is rubber) into the curl with end carried on a chuck.
- Dryer is not used generally.

Above mentioned line consists of hand-fed machines, and two or four machines are used in each technological phase. This type of line has a capacity of 1000-2000 cans per eight hour shift.

In Vinh Phu Canning Factory (70 km from Hanoi) there are two BLEMA type can-making lines made by BLECHBEARBEITIGUNGS MASCHINEN WERKE-AUE (GDR) built up in 1966. This equipment is in very poor condition . The soldering device is deconnected from bodymaker and the cans are soldered by hand-work. The other parts of line are used with reduced capacity.

In Dong Nai Canning factory (20 km from Ho Chi Minh City) there are some excellent can-making machines. For the sanitary can-making the following complete equipment was found :

(a) Body-making

- Tandem slitter (Bliss 5325) slits the sheets into body widths and removes two scrap edges in the first operation, and slits the widths into body heights and removes the remaining two scrap edges in the second operation.
- Body-maker (made by Bliss) is a straight line machine carrying out following operations :
  . the first operation is to give a preform to prevent local deformation by passing the blank around a small-diameter roller;
  . the second operation notches the corners to allow only two metal thicknesses in the side seam where the double seam will be ultimately made;
  . the third operation forms hooks at 90° down to edges where the side seam will be made;
  . the fourth operation further forms hooks;
  . the fifth operation forms the body bending round on mandrel which expands to engage the hooks and the hooks are hammered flat. The hooks are fluxed for soldering purpose;
  . after preheating the body is contacted at side seam by solder roll rotating in molten solder bath which wips solder into side seam. The complete heating system made by Flynn Burner Co. Serial No 731266.
- Flanger (Bliss 1315) is a six-head machine. The bodies pass into this operation on a conveyor runway system. The body passes through the flanger where both ends are flared out.
- Double seamer (Angel Serial No 88 62 874) applies and seals one end to the body. The conveyor system takes the body to this machine. In this conveyor system has a storage compartment.

(b) End-making

- Two shears (Bliss 1225) cut the strip from tinplate sheets.
- Two presses (Bliss 1831) are inclined open-fronted machine with automatic feed for strips. Strips are hand fed to a magazin when suction cups lift them to a stepping feed, feeding to the dies. Blank and draw take place in one operation. The press with double dies is running 80-100 strokes/min
- Two curlers (made by National Machines Tool Builders Assn.) which complete the metal-forming of end. Ends drop through the press into this equipment . Curler forms the stamped lid to contain a compound. Curling

takes place between a rotating inner disk and a stationary annular tool both suitably profited.

- Two lining machines (DAREX) Solvent based compound is sprayed into the curl. Centrifugal force plus the initial placement determines the final placement of compound.
- Two dryers (Darex, 72 dryers 7-74) is electric heated, equipped with thermometer, variable speed.

These machines are set up in 25 m width and 35 m long building. A lot of machines of line are out of work, because the factory has no spare-parts and it has no possibility to buy tools and different spare parts.

3. Present status of tinplate lacquering

Electrolytic and hot dipped tinplate containers are frequently lacquered fully or partly internally to provide additional protection and/or to enable thinner tin coatings to be used. In Viet Nam the following lacquering facilities could be found.

Hanoi Canning Factory

The spray type lacquering line consists of the following individual machines :

- Two sprayers (unknown manufacturer). Thismachine has a rotating table on that eight also rotating disks. The cans are placed by hand to disks and that turns under the spray head. Height of head theoretically can be regulated.
- Dryer oven (unknown manufacturer) is a belt conveyor type equipment with variable speed drive and direct oil heating.

This lacquering is not used in can-making business except some of lacquers may be sprayed on as a second coating after the can has been made from tinplate pre-coated with a heat resistant lacquer. Important properties required in all lacquers include an ability to spread evenly and completely over tinplate surface which have received no special post-manufacture treatment, and to adhere to the surfaces under what may be adverse conditions. This lacquering system does not comply with the requirements of canning industry :

- There is no heat resistant lacquers to be sprayed.
- The nozzle sprays only the can-body with lacquers, although the lids would be coated in some case (see Appendix 2)

- Thickness and quantity of lacquering can not controlled.
- There is a lot of waste of lacquers.
- The machines are out of date in every respect.

Can-making Factory in Ho Chi Minh City

There is an old type coating line, which consists of the following equipment :

- Feeder conveys the sheets to the printing machine.
- 3 single-colour metal decorating presses. Each printing machine has three cylinders: the plate cylinder around which is wrapped the metal printing plate, the blanket cylinder, which transfers the design and which has one rubber blanket tensioned around it, and impression cylinder, which acts with the blanket cylinder to impart the desired "nip" to the sheet. The sheet passes under pressure through the nip between blanket and impression cylinders and receives its impression. Three colours could be applied to the tinplate surface, one after the other, printing wet-on-wet.
- Lacquering machine, roller type. A steel roller rotates in a feed tray containing lacquers which is transferred to a distributor roller and an applicator roller. A pressure roller acts in conjunction with the applicator roller to drive the sheet through the nip. The heater was not fitted. Surplus coating material is removed from the pressure roller by a scraper knife and recycled.
- Oven stoves coating materials. A conveyor transports the sheets through the oven where they are baked. The length of this oven is approximately 18 - 20 metres.

These machines have been out of order for a long time. Condition of this equipment is very poor. The manufacturer is unknown; they were built in Taiwan. In my view, these machines cannot be repaired.

The main problems in the field of can-making and lacquering can be summarized :

- There is no standard concerning can-making.

- They have no quality requirements and control system concerning raw materials used for can-making (tinplate, lacquered tinplate, lacquers), nor quality control of cans.
- The existing spray lacquering system does not comply with the requirements of canned food.
- The existing can-making machines (BLEMA and BLISS) are in bad repair.

4. Development of Can-making and Lacquering of Tinplate

From the above-mentioned, it can be seen that the development of Vietnamese can-making is timely.

The development could be justified :

(a) In the near future, Government wants to increase the production of canned food shown in Appendix 8. That means they have to increase the can-making activity, too.

(b) The main reason for the increasing of production is export. The quantity of canned food that will be exported in the future is as follows :

in Metric Tons

Year	Production	Export
1985	27,500	25,000
1990	70,500	64,000
1995	88,000	80,000
2000	100,000	90,000

Note: It is very difficult to imagine that the export could be increased by more than 20 % a year; such high increase is not usual in the case of a traditional product on the food market.

(c) The heavy metal (Sn, Zn, Pb, Fe) contained in canned food is limited by Food Law in some countries. In our case, this value could not reach 100 mg/1kg product. This value in unlacquered cans is 190 mg/1kg product after nine-month storage.

(d) There is no doubt the present practice could not be followed in canning factories. Without quality control of raw materials used for can-making or quality control of can-seaming in the food industry, it could not be followed.

(e) Above mentioned problems could not be solved by imported lacquered tinplate because the lacquer coating can be scratched during transportation.

Quantity of tinplate to be lacquered

I was informed in visited canning factories concerning the quantity of tinplate used for can-making and demand for cans to be filled. In My Chau Canning Factory, 2,200 cans were used for 1 metric ton of canned food products and 110 kg of tinplate were used to produce 1,000 cans.

My note : This is extremely high tinplate consumption. In internationalpractice, 85 - 90 kg of tinplate are used to produce 1,000 cans.

The Vietnamese canning industry wants to produce 50,500 Tons of canned fruit, that means they need approximately 111 million cans. They need, according to their tinplate consumption, approximately 1,200 Tons of tinplate to make this quantity of cans.

In accordance with international practice (see Appendix 2), in the case of pineapple (chunks, slices in syrup),only the lids have to be lacquered. Tinplate concumption for this purpose is 3,200 Tons. This quantity of tinplate corresponds to 3.2 million tinplate sheets.

20,000T are for the rest of products/that have to be filled into lacquered cans. (Supposedly, these are vegetables, meat or other such types of products.)
For that purpose, they need 44 million cans and approximately 4,800 Tons tinplate to make this quantity of cans, that means their consumption is 4.8 million tinplate sheets.

The capacity of the line for carrying out the above mentioned operations is :

- the sheets for lids must be lacquered two times, that means
  3.2 million sheets x 2 = 6.4 million passing through
- the sheets for other cans must be lacquered one time, that means
  4.8 million sheets x 1 = 4.8 million passing through.

For this purpose, they need a lacquering line which has a capacity of 11 million sheets yearly.

RAW MATERIALS USED FOR CAN-MAKING

I. TINPLATE

The term tinplate refers to low carbon mild steel sheet thickness from around 0.15 mm to 0.5 mm with a coating of tin between 2.8 g/m2 and 17 g/m2 (0.0004 mm to 0.0025 mm thick) on each surface of material. The method of tin application was traditionally by the Hot Dipping Process but in 1950 S.,the electrolityc deposition of tin was adopted commercially and has since become the standard method of manufacture for the majcrity of commercially used tinplate. Differential tinplates, plate with different tin coating weights on each side of the plate, were first used in 1960 S. The Union of steel and tin produces a material with high strength and good fabrication qualities having a corrosion resistant surface of bright appearance , suitable for printing/coating with organic lacquer systems and inks.

The chemical composition of the base steel has a very significant effect on the subsequent corrosion resistance and mechanical properties of the tinplate. For the packaging of acidic agressive foods, high purity steel may be used.

Tinplate, in addition to the corrosion resistance gained from the tin surface layers, in further protected by two surface treatments, passivation and oiling. The passivation procedure stabilizes the surface on the tin coating by controlling the growth of naturel oxide film. Uncontrolled oxide growth can cause a yellow discoloration of the plate surface and effect subsequent print or lacquer adhesion. The most commonly used passivation treatment for tinplate is a cathodic electrochemical process using sodium dichromat solution.

Surface oiling is the last procedure in the manufacture of tinplate and is designed mainly to lubricate the plate to improve the slip characteristics and reduce surface scratching and adhesion when the plate is subsequently fabricated into cans. The most common lubrication system used is dioctly sebacate (DOS) applied by electrostatic precipitation or direct plate immersion. The level of oil application is controlled carefully since excessive oil film can cause dewetting of lacquers applied during subsequent container manufacture. The term tinplate is really a generic name for a complex family of commercially available tincoated low-carbon steel material varying in plate gauge hardness, surface roughness, tin coating weight and base steel composition. All features of tinplate and quality control method are collected and suggested in the next chapter.

II. TINPLATE TESTING

The tests which may be applied to tinplate can broadly be classified into two groups, objective or quality tests and subjective or performance tests. Many of these tests are routinely carried out on receipt by the customer as part of a quality control programme. The validity of any testing procedure is based on the assumption that the samples selected are representative of the bulk of the material to be tested.

Mechanical property tests

Hardness :

The Rockwell superficial hardness tester is a direct reading instrument which measures the incremental depth of penetration of a ball indentor forced into the metal by a primary and a secondary load. In the superficial tested as used for tinplate, the minor load is 3 kg and the major load a total of 30 kg or 15 kg. The loads are applied via a system of levers and at controlled rate. The hardness value is read directly on a calibrated dial. To carry out the test, place the specimen on the diamond centre spot of the anvil, avoiding testing near the edges of the specimen because of a possible cantilever effect. Bring the specimen into contact with the ball indentor by turning the hand wheel until the indicator on the dial shows that the minor load is applied. Then turn the adjustable rim of the dial until the pointer reads zero, and apply the major load by operating the handle. The rate of loading is controlled by a dash-pot incorporated in the machine. As soon as the loading is complete remove the major load by pulling the handle forward and read the Rockwell hardness number on the appropriate scale.

The Jenkins bend test

In this test a strip of tinplate, approximately 60 mm long by 12 mm wide is clamped between accurately radiused jaws and the free end is repeatedly bent to and for through 180° until failure occurs. In the Jenkins machine the specimen is bent by a fixed diameter roller operated by a hand leved, the end point being reached. at the first sign of fracture through the specimen. The numbers of full

180° bends required to produce the fracture is recorded as the Jenkins Bend value (the first half bend is ignored). It depends on the temper grade and the sheet thickness.

When carrying out an alternating bend test, two specimens should always be taken, one cut with its long edges parallel to the rolling direction and the other at right angles to this direction. The difference between the two bend values and the magnitude of the "weak way" value are both significance and are particularly useful in estimating bending and flanging properties.

Cupping tests

The draw-ability of sheet metal is commonly assessed by means of cupping tests. The principle underlying all cupping tests is that a cup is formed in the sheet specimen by means of a punch and die set mounted in a suitable press, the sheet being clamped by a pressure plate or mounting ring. The cupping value normally taken as the depth of impression required to produce fracture, although other criteria may be used. For routine testing the test most frequently used for tinplate is the Erichsen cupping test. In the Erichsen test the test piece is a 76 mm blank, held between an annular ring and the die, the punch is a 20 mm diameter hemisphere and it is advanced against the specimen mechanically to form a depression or "cup". The end point is normally taken as the point at which the cup walk just fractures. The depth of impression, in millimetres, is the Erichsen value. It is related to the tinplate temper grade and the thickness of the material.

Porosity test (Sulphur dioxid test)

The sample is exposed for a fixed period to an atmosphere containing a small amount of sulphur dioxid. Under conditions, rust spots form at pores, whereas areas of continuous tin coating are unaffected.

The test sample is first cleaned by cathodic -anodic- cathodic treatment in 1o/o sodium carbonate solution at room temperature, and then well rinsed (in water, followed by acetone or ethanol) and dried.

Test samples are suspended, by means of glass hooks hanging from a plastic frame, within a vessel fitted with an airtight closure. The vessel contains a volume of sodium thiosulphate solution (10 g sodium thiosulphate per litre water) equal to 1/20-th of the vessel's capacity, to which has been added 0.1 N sulphuric acid (4.9 g/L H_2SO_4) in the ratio 1 part acid for every 10 parts thiosulphate solution. The ambient temperature is maintained at $23 \pm 3^{\circ}C$. The samples are suspended in

such a way that no part of their surface of the solution, making sure that each specimen is separated from its neighbours or the wall of the vessel by at least 20 mm. After adding the sulphuric acid the specimens are suspended in position within 5 minutes, the vessel is then closed and left undisturbed for a suitable period. Usually 16-24 hours is sufficient to allow rust to develop at all pores, if longer periods are employed, spread of rust may obscure single pore sites.
At the end of the test period, the test samples are removed and inspected.
They may be compared with previously prepared reference samples, alternatively a pore count may be made. Because pore densities may be of the order of 100/cm2, it may be impracticable to count each pore separately, the surface may be covered by a graticule marked in 0.5 cm squares, and the pores counted at a magnification of x 5 on a number of squares distributed at random over the test area.

Oil film determination

The Oil film customerily present on electrolytic tinplate is di-octyl sebacate or acetyl tributyl citrate. On hot dipped tinplate there is a residual film of palm oil.
The simplest test, which merely indicates the presence or absence of oil, is the "Water-bread" test, in which a tinplate sheet is momentarily dipped in water, and and then examined for areas where the water remains.

Solderability testing

An important attribute of tinplate is its ability to be soldered with case and rapidity. The speed at which soldering takes place or bodymaking lines means that very rapid solder wetting of tinplate and capillary filling joints is essential. Although general solderability testing methods involving wetting time or area of spread measurements are also applicable to tinplate, there is simple capillary rise tinplate solderability test that is commonly used.
In this capillary rise test, a strip of tinplate, about 75 mm long by 25 mm wide is folded lengthwise to form a tube of pear-shaped cross-section such that the gap between the opposing surfaces tapers from 0 to about 5 mm. The gap is flaxed and one end of the specimen is immersed vertically to a depth of about 30 mm in a small bath of molten solder. A draught shield is used to minimise temperature fluctuations. Alter a brief period, which may be varied to obtain a relation of the result to time, the folded test-piece is with drawn and allowed to cool. The fold is slit open and the capillary is measured. This test gives a relative assessment of solderability, it does not provide absolute value.

III. INTERNAL LACQUERS FOR SANITARY CAN

The insides of food cans are lacquered to prevent interaction between the product and the container. Unsatisfactory lacquer performance may result in perforation of the container or deterioration of the product, or both. It is therefore clearly desirable to evaluate as fully as possible the performance of lacquer prior to their commercial adoptation as protective coatings.

A lacquer for the internal use in sanitary cans must meet the following requirements :

- good elesticity
- chemical resistance
- excellent off-taste properties
- good adhesion to tinplate
- good scratch resistance

Internal lacquers are in direct contact with food. Therefore, it is absolutely necessary that those products meet the food low regulations.

During the processing of meat and vegetable packs, hydrogen sulfide is liberated and may give rise to underfilm staining (tin sulfide) and blackening (iron sulfide). The latter normally occurs at the headspace and it is the more commercially unacceptable of the two effects. The main factors affecting blackening are :

- protein degradation of the food
- processing temperature control
- air content of the headspace
- iron exposure in the headspace

In two main groups can be collected the products made canning industry in Viet Nam :

- acid packs
- sulphure containing food packs.

Acid packs

It is important to note first of all that not all acid packs require a lacquer lining (see Appendix 2). In fact for many acid products the presence of tin is desirable, because it eliminates oxygen which would otherwise be retained in the can and cause discoloration of the contents. The distinction applies mainly to acid fruits where it is necessary to distinguish between fruits which have a clear juice and those which have a red or blue juice.

In the first category are fruits such as peaches, pineapples etc.. Which require the presence of tin and which are normally packed in cans made of electrolytic plate is often used on the ends of such cans as a commercial feature since the presence of the lacquer is an attraction when the can is opened. If these fruits are packed in completely lacquered containers, the juice will become cloudy, and discoloration through oxidation may take place with consequent softening of the fruits.

On the other hand in the case of fruits which contain arthcyanin pigments such as strawberries, plums, etc..., the fruits must be packed in totally lacquered can because the juice will be quickly discoloured or bleached by contact with tin or iron. For example experiments have shown that two parts of million of iron in a pack of strawberries are sufficient to produce discoloration.

In order to achieve a satisfactory result with these fruits every effort must be made to prevent all contact between the juices and the tin plate.

For some packs this is not important, but in an acid pack these pinholes form the centre of attack, and the contact between the juice and tin or iron will eventually cause discoloration of the contents and a gradual break down of the lacquer film. For there packs therefore it is necessary to consider the application of <u>two coats</u> of lacquer. The second coat effectively covers any imperfection in the first film and the presence of a double film, whose the first coat has been twice stoved, presents a more hard surface with greater resistance to mechanical damage during handling. Either <u>epoxy-phenolic</u> or <u>oleo-resinus</u> lacquers are normally used for these two coat applications.

Apart from coloured fruits the same double-lacquered cans are used for other strongly acid packs such as pickles, cucumbers, beetroot, etc.

Tomato concentrate is also included in this category but whole peeled tomatoes and tomato juice are packed in unlacquered cans for reasons of taste. This is certainly not because the lacquer may give a flavor to the tomatoes, but simply because the characteristic flavour of whole tomatoes and tomato juice in cans comes from contact with tin, and fully lacquered cans do not allow this flavour to develop.

Sulphur containing food packs

When considering sulphur-bearing foods it is always important to make a clear distinction between solid and liquid packs. Solid packs include luncheon type product which are not in a liquid sauce (that has not been made in Viet Nam this moment). This type of product requires a lacquer which will present a barrier to the sulphur products in the pack and will therefore prevent sulphur blackening of the tinplate. For many years <u>phenolic lacquers</u> have been the generally accepted standard for sulphur resistance and they are still widely used for a range of these products. In many cases, when the polyphosphates and other preservatives are added to product, change to epoxy-phenolic lining has been made in recent years. This has been due to the fact that epoxy phenolic lacquers have greater resistance than phenolics the mentioned materials. Epoxy-phenolic lacquers on the other hand have rather less resistance to sulphur than pure phenolic ones, and it has become normal to incorporate aluminium pigment in order to mask any eventual sulphur staining which may take place on the surface of the tinplate. In view of the flexibility of epoxy-phenolic blends these aluminium pigmented lacquers are suitable for sanitary three-piece soldered cans.

Liquid sulphur packs including vegetables such as peas or beans and some meat in brine and shell fish are dealt with in a different way. During sterilisation the sulphur products which are formed in the pack can move freely through the liquid and are particularly concentrated in the headspace of the can. If a barrier type coating is used the sulphur products in the headspace may produce an unpleasant smell when the can is opened. For this reason it is important to absorb and neutralise the sulphur compounds which are liberated in a liquid pack. There are two ways to do this, and the first is to use an Oleo-resinous lacquer pigmented with zinc oxide. During sterilisation the oleo-resinous lacquer softens under the influence of heat, and this permits the sulphur compounds which are formed in the pack to react with the Zinc oxide. The reaction produces zinc sulphide which is white in colour and which is harmless. It is possible to use this type of lacquer on bodies and ends of cans, but it is more normal to use phenolic or epoxy-phenolic lacquer on the bodies in order to have a better resistance to scorching along the seam during the soldering operation . The quantity of zinc oxide in the lacquer on two ends of the can is usually sufficient to absorb and neutralise the sulphur compounds liberated in vegetable packs.

For those products which have a higher sulphur content it is normal to use the pigmented lacquer over the whole of the can, and low temperature solder is used which limits the side-seam burning to the minimum.

It is important that acid products should not be permitted to come into contact with lacquers containing Zinc oxide because the reaction may produce Zinc salts which could be harmful to health and which could destroy the continuity of the film. The second method widely used for liquid vegetable and meat products is more simple system of leaving the body of the can unlacquerred. The sulphur products are removed by being absorbed on the surface of the tinplate which consequently becomes blackened. This gives an unpleasant appearance and in order to reduce this effect the ends of such cans are sometimes lacquered so that when can is opened it has a clean and hygienic look.

IV. EXTERNAL LACQUERS FOR SANITARY CAN

The external coating systems must withstand most the same requirements as for the internal lacquers. Most times there are three possibilities for an external decoration :

- Just a protection lacquer which might be a goldlacquer or clear varnishing
- White enamel, inks and clear varnish
- Printing inks and clear varnish

V. TESTING OF LACQUERED PLATE

It is normal that the following tests are carried out :

- film weight
- adhesion
- scretch - resistance
- drawability
- porosity
- sterilisation test
- solder scorching test

Film weight

The film weight should be measured by delacquering a piece of tinplate and by weighing it with a lab balance with and without lacquer. The difference, of course, is the amount of lacquer on the tin sheet and from this amount of lacquer can be calculated per square meter. The dry film weight is normally calculated in grams per square meter (g/m2).
Several methods for removing fully cured films of lacquers have been developed, of which the following are the most used.

(a) - For delacquering tinplate, a solution of water and ethylglycol mixed in the ration 1 : 1 and sodium hydrate can be used. This solution should be brought up to a temperature of appr. 95-100°C. After 15 sec. remaining in this hot solution the tinplate can be delacquered without any problem.

(b) - This is an electrolysis method. A 2 % solution of sodium carbonate is used as an electrolyte, and a Cathode and Anode are suspended in the solution. The specimen is firmly fixed to the Cathode either by rubber band or by magnetic system, and a current of up 10 amperes at 20 volts is passed through the system.

The lacquer film is quickly removed from the plate. The Cathode is usually a metal phase and the Anode a copper rod.

Adhesion

The adhesion is tested mostly with a so-called tape-test. Parallel scratches are brought on the lacquer surface in a distance of appr. 1 mm to each other and crosswise. Minimum 20 scratches have to be made. On top of this a so-called scotch tape is applied and then torn off as fast as possible. The inspection of the plate afterwards and the tape will show how good the adhesion was, depending on the amount of lacquer which could be removed by the tape.

Scratch resistance

The scratch resistance can be measured by the so-called pencil hardness. Because the hardness of the pencil is defined a relation to be lacquer can be made.

Drawability

The drawability is tested with the Erichsen instrument with the Erichsen machine test caps can be made for the inspection of the drawability. However, those is a big difference and a fast running stamping equipment with the Erichsen the cap is drawn slowly and with the stamping machine of course, it is stamped rapidly. For this reason a lacquer should be tested also on the normal equipment in this view.

Porosity

To test the porosity of a lacquer film the following solution can be used :

20 % copper sulphate - 5 % hydrocloric acid in water. If a test piece is coming in contact with the above mentioned solution, metalic copper will show the pores of the lacquer film, because it will appear on places those the tin is not covered by the lacquer. Because of this reason the pores and scratches can be seen by dark brown spots.

Sterilisation tests

Sterilisation-proof internal lacquers are mainly tested with the following solutions at 121^{o}C for 30-60 min :

(a) Fresh water, or

(b) Water - 2 % acetic acid - 3 % sodium chloride, or

(c) Water - 1 % citric soid - 0.5 % tartaric acid, or

(d) Water - 1 % lactic acid, or

(e) Water - 3 % sodium chlorid - 0.3 % K_2HPO_4 or Na_2PO_4 (meat products) or

(f) Water - 10 % gelatin * 5 % sodium chloride - 0.1 Na_2S (sulphur containing food)

After sterilisation no changes of the lacquer film should have taken place. In case of meat lacquers a sterilisation test at 121^{o}C for 60 min. Should be done. Aftrr sterilisation no sulphurstaining should be seen on the tinplate. Certainly the above mentioned tests can be modified to meet special requirements, but mostly they are carried out as described above.

Solder scorching test

Lacquer intended for side seam soldered cans must be able to resist, in addition to severe deformation, scorching during the soldering operation. Certain lacquers, for example Zinc oxide-pigmented oleo-resinous materials are more sensitive then others to heat and, to facilitate the assessment of scorching resistance, the following test has proved of some use.
They employ resistance heating of the lacquered plate to simulate the heat of soldering. A disadvantage of this approach is that the temperature reached by the plate is very short time that it is heated can not be measured easily.

APPENDIX 2

RECOMMENDED TIN COATING AND LACQUERING IN CASE OF VARIOUS CANNED PRODUCTS

PRODUCTS	Body (Internal)		Lid (Internal)		Bottom (Internal)	
	Tin coating g/m^2	Lacquering	Tin coating g/m^2	Lacquering	Tin coating g/m^2	Lacquering
FRUITS						
Pineapple slices	12,5	No	25,0	Yes	12,5	Yes
Apricot	11,2	No	5,6	Yes	2,8	Yes
Strawberry, raspberry etc...	15,0	Yes	30,0	Yes	15,0	Yes
Fig	11,2	No	5,6	Yes	2,8	Yes
Fruit coctail	11,2	No	5,6	Yes	2,8	Yes
Cocc[illegible]c (Fresh)	65,6	Yes	11,2	Yes	5,6	Yes
Grape	12,5	No	5,6	Yes	2,8	Yes
Pineapple juice	12,5	No	25,0	No	12,5	No
Grape fruit juice	11,2	No	22,4	No	11,2	No
Orange juice	11,2	No	22,4	No	11,2	No
Lemon juice	15,0	Yes	30,0	Yes	15,0	Yes
Grape fruit juice concentrated	2,8	Yes	5,6	Yes	2,8	Yes
Orange juice concentrated	2,8	Yes	5,6	Yes	2,8	Yes
Lemon juice concentrated	2,8	Yes	5,6	Yes	2,8	Yes
Grape	11,2	Yes	22,4	Yes	11,2	Yes
Jam Marmalade (bright) except lemon and orange	12,5	No	5,6	Yes	2,8	Yes
VEGETABLES						
Artichoke	12,5	No	5,6	Yes	2,8	Yes
Beetroot	12,5	Yes	25,0	Yes	12,5	Yes
Cauliflower	12,5	No	5,6	Yes	2,8	Yes
French been (green)	12,5	No	5,6	Yes	2,8	Yes
Potato	12,5	No	5,6	Yes	2,8	Yes

Carrot	11,2	No	5,6	Yes	2,8	Yes
Pumkin	11,2	Yes	22,4	Yes	11,2	Yes
Peperoni	12,5	No	5,6	Yes	2,8	Yes
Mushroom	2,8	Yes	5,6	Yes	2,8	Yes
Rhubarb	15,0	Yes	30,0	Yes	15,0	Yes
Spenach	12,5	No	5,6	Yes	2,8	Yes
Whole tomato	11,2	No	5,6	Yes	2,8	Yes
Cabbage	12,5	No	5,6	Yes	2,8	Yes
Onion	12,5	Yes	25,0	Yes	12,5	Yes
Tomato juice	11,2	No	5,6	Yes	2,8	Yes
Chili souce	12,5	Yes	25,0	Yes	12,5	Yes
MEAT PRODUCTS						
Cooked meat(beef, veal,lamb)	12,5	No	25,0	No	12,5	No
Meat in yelly	2,8	Yes	5,6	Yes	2,8	Yes
Meat in sauce	12,5	No	25,0	No	12,5	No
Luncheon-meat	11,2	No	5,6	Yes	2,8	Yes
Chopped (pork or beef)	15,0	No	30,0	No	15,0	No
Sausage in brine	2,8	Yes	5,6	Yes	2,8	Yes
Tongue	2,8	Yes	5,6	Yes	2,8	Yes
Liver paste	2,8	Yes	5,6	Yes	2,8	Yes
Ham and eggs	2,8	Yes	5,6	Yes	2,8	Yes
Poultry	2,8	Yes	5,6	Yes	2,8	Yes
Fish in oil	5,6	Yes	11,2	Yes	35,6	Yes

APPENDIX 3

Seam of can examination, equipment and method

This part is concerned primarily with the evaluation of dimensional quality of the double seam. The features to be measured are as follows :

(a) Seam length
(b) Seam thickness
(c) Countersink depth
(d) Body hook length
(e) End hook length
(f) Thickness of body and endplates, to assess in conjunction with (b), the true tightness of the seam. See the double seam dimensional terminology in Appendices 4 and 5.

Features (a), (b) and (c) are measured before tearing down the seam, and (d), (e) and (f) after this operation. It is essential that features (a) - (e) inclusive be measured at the same location, this being achieved by marking the desired sites of examination in the seam and on the body wall at the outset. The number of sites around the can at which measurement is made will vary from two to four according to the purpose of the examination.

Length and thickness of seam

A special "seam" micrometer, calibrated to 0.025 mm is recommended for all seam measurement. In measuring seam length, the micrometer anvil is engaged under the double seam and the measurement made in the normal way by rotating the micrometer thimble until the shank reaches the top of the seam; undue pressure must not be used.

To measure seam thickness, the micrometer is held across the can and so that its anvil is against the inside surface/"chuck wall" of the seam. As the seam is not exactly parallel to the can axis, the micrometer should be slightly clear of the end bead; this will ensure that the micrometer will be measuring the true seam thickness as contact is made between the micrometer and seaming wall.

Countersink depth

This feature can be measured by two methods :

- Precise measurement can be made using a dial depth gauge, with or without a reference bar. With the bar technique, the gauge is "zeroed" to the under side of the bar, countersink depth being thus obtained by direct reading. Without the bar, readings are taken to the top of the seam and to the countersink, the difference between these two giving countersink depth.
- An alternative method of measuring countersink depth is by using a seam micrometer.

<u>Measurement of body hook and end hook lengths</u>

Before proceeding to measure the remaining features, the seam must be torn down. After tearing of double seam, both dimensions are measured by means of the special seam micrometer. For body hook length, the micrometer anvil is engaged underneath the cut edge of the hook, the micrometer being held parallel to the can axis, and the sleeve rotated until the shank contacts to body hook radius.

The measure end hook is held between the thumb and forefinger of the left hand and placed in the micrometer so that the end hook outer edge is butting against the micrometer anvil.

To prevent errors due to the end hook slipping between the anvil and shank while the thimble is rotated, it is essential that the end hook itself and not outside portion be parallel to the micrometer axis.

Actual overlap may be determined from the following formula :

$$\text{Actual overlap} = x + y + 1.1t_e - L$$

The body end hooks must overlap sufficiently to ensure that the compound is properly held under compression with a correct seam tightness.

Overlap of body and hook should be as large as possible, consistent with freedom from wrinkles. Percentage overlap can be determined by the following methods

- percentage overlap should be calculated from formula :

$$\text{percentage overlap} = \frac{x + y + 1.1t_e - L}{L - (2.2t_e + 1.1t_b)}$$

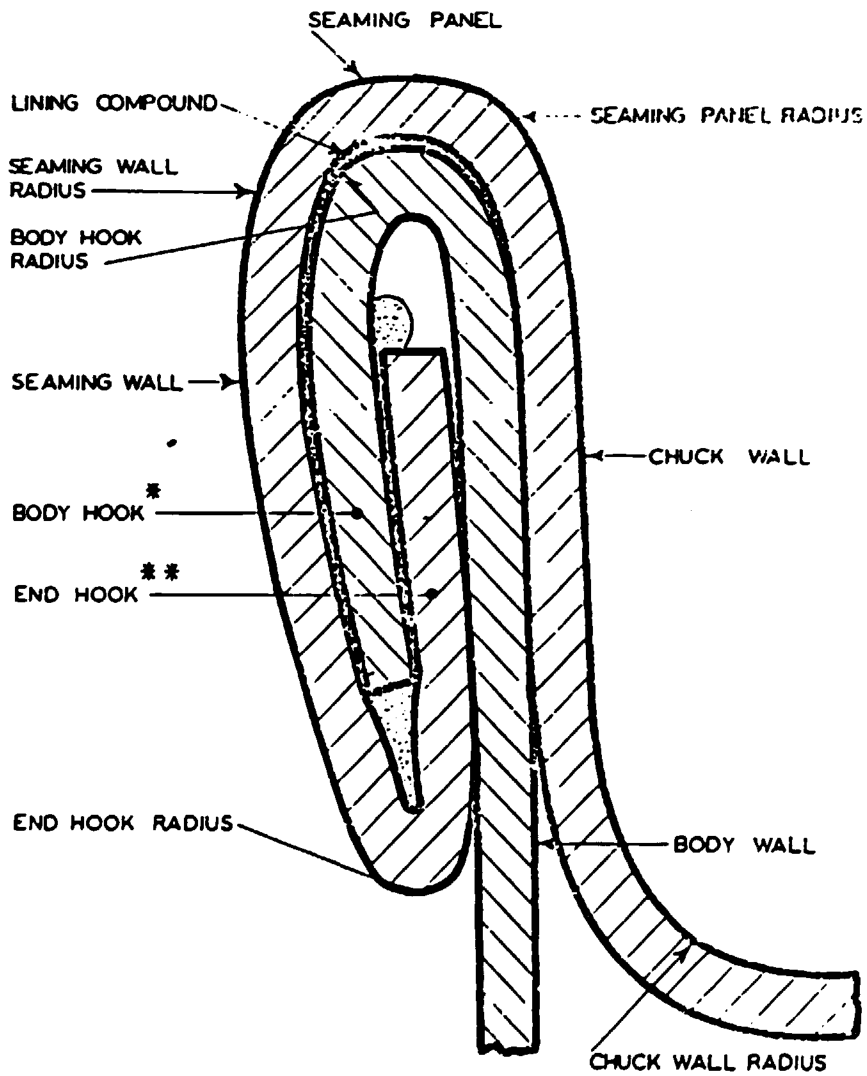
Overlap of 100 % cannot be obtained in practice, but experience shows that a minimum of 43 % is required to ensure an adequate seal.

Plate thickness

Both body plate and end plate thickness must be measured, in order that the true seam thickness be compared with the ideal seam thickness. An accurate ball-pointed micrometer,graduated to 0.05 mm is generally used. It is equally important to confirm the tightness by determining the free space of the seam. The free space of the seem is derived from the formula :

$$\text{Free space} = \text{Seam thickness} - (2t_b + 3t_e)$$

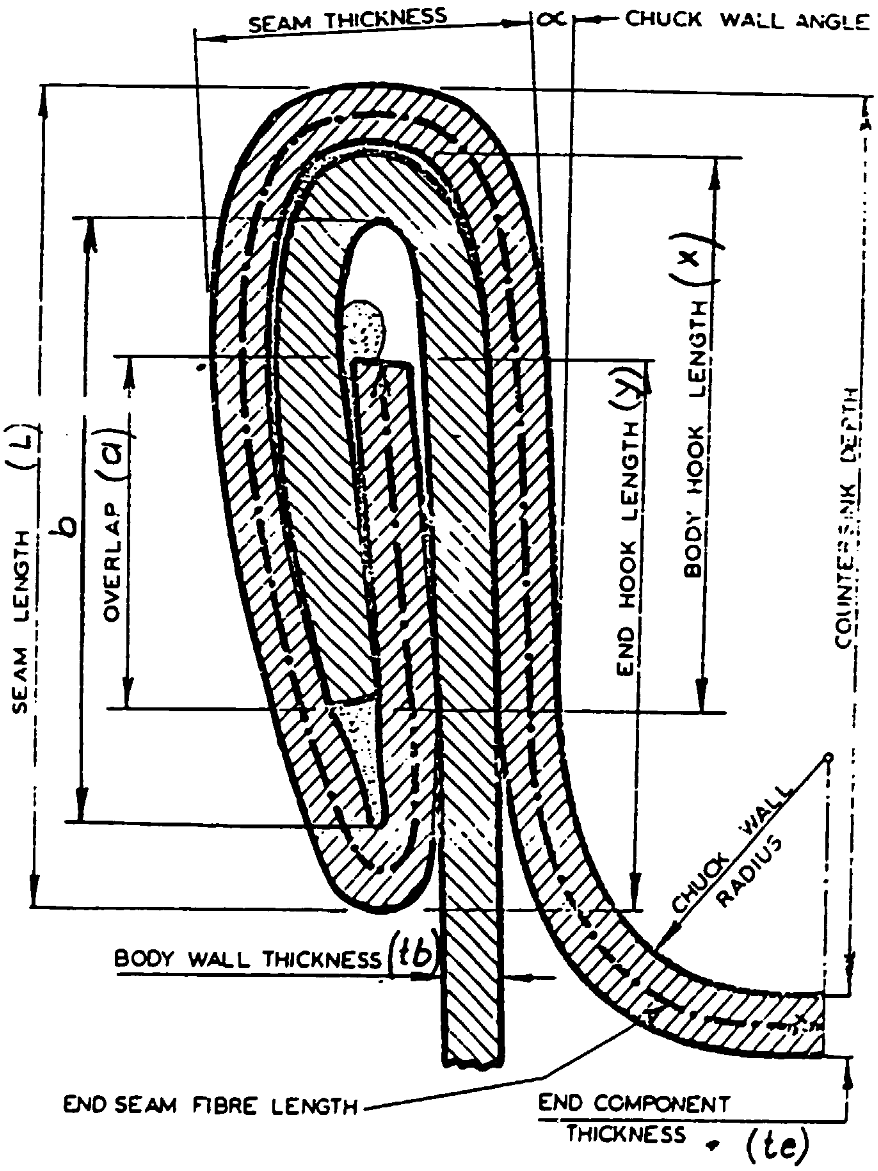
Double seam general terminology



* ALSO REFERRED TO AS CAN HOOK

** ALSO REFERRED TO AS COVER HOOK

Double seam dimensional terminology



Appendix 6

LIST OF PERSONS MET AND FACTORIES VISITED

(1) Mr. TERENCE JONES, DRR	UNDP Field Office
(2) Mr. WOLFGANG SCHOLTES, ARR	UNDP Field Office
(3) NGUYEN VAN PHUOC	Director of Foreign Economic Relations Department-Ministry of Food Industry HANOI
(4) NGUYEN QUOC DAT	Senior Officer of Foreign Economic Relations Department - MFI
(5) NGUYEN VIET DUNG	Deputy Manager of Foreign Service Bureau-MFI
(6) DO TRONG LUONG	Director of VINH PHU Canning Factory
(7) DINH THE BAO	Vice General Director of the Canning Enterprises Union 1st
(8) NGUYEN NGOC TRUAT	Vice General Director of the Canning Enterprises Union 1st
(9) NGUYEN VAN UOC	Vice Director of Hanoi Canning Factory
(10) NGUYEN DANG HAI	Vice Director of the Canning Research Centre, HANOI
(11) LE NGOC SAU	Vice General Director of the Canning Enterprises Union 2nd
(12) NGUYEN VAN TIEP	Chief of the Technical Department-CEU 2nd
(13) TRAN QUANG NHUNG	Vice General Director - CEU 2nd
(14) TRINH KIM HUNG	Director of DUY HAI Canning Factory - HO CHI MINH CITY
(15) NGUYEN KHAC TRAU	Vice Director of DUY HAI Canning Factory HCMC
(16) TRAN CONG TIET	Director of TAN BINH Canning Factory HCMC
(17) PHAM VAN NAM	Director of Can-making Factory- HCMC
(18) NGUYEN THUY XINH	Director of MY CHAU Canning Factory
(19) NGUYEN THI THOM	Director of DONG NAI Canning Factory HCMC
(20) DOAN THI THO	Vice Director of DONG NAI Canning Factory
(21) TRAN VAN NAI	Director of LAM DONG Canning Factory (app 200km from HCMC)

Appendix 7

ADDRESSES OF EXISTING CANNING FACTORIES

Name	Address	Supreme authority
1. SON TAY Canning Factory	HANOI	Local Committee
. Canning Enterprises Union 1st		
2. HANOI Canning Factory	HANOI	MFI
3. VINH PHU Canning Factory	VINH PHU province	MFI
4. HAI HUNG Canning Factory	HAI HUNG province	MFI
5. NAM HA Canning Factory	NAM DINH city	MFI
6. NGHIA DAN Canning Factory	NGHE TINH province	MFI
Canning Enterprises Union 2nd		
7. DONG NAI Canning Factory	DONG NAI province	MFI
8. TAN BINH Canning Factory	HO CHI MINH City	MFI
9. MY CHAU Canning Factory	HCMC	MFI
10. DUY HAI Canning Factory	HCMC	MFI
11. LAM DONG Canning Factory	LAM DONG province	MFI
12. Can-making Factory	HCMC	MFI
13. HOANG LIEN SON	HOANG LIEN SON PROVINCE	Local Committee
14. LINH XUAN Canning Factory	HCMC	Local Committee

Note : MFI = Ministry of Food Industry

Appendix 8

PRODUCTION OF VIETNAMESE CANNING INDUSTRY

In metric Ton

Canning factory	1985	1990	1995	2000
1. Ha Noi	3000	5000	5000	5000
2. Vinh Phu	1500	5000	8000	10000
3. Hai Hung	2000	3000	3000	3000
4. Nam Ha	2000	3000	4000	5000
5. Ngia Dan	500	2000	5000	10000
6. Son Tay	2000	3000	4000	5000
7. Hoang Lien Son	500	1000	2000	3000
8. Dong Nai	4000	4000	5000	5000
9. Tan Binh	2500	3000	3000	4000
10. My Chau	4500	6000	10000	10000
11. Duy Hai	3000	3000	4000	4000
12. Linh Xuan	2000	3000	3000	4000
13. Lam Dong	-	1500	2000	2000
14. Tien Giang	-	5000	5000	5000
15. Hau Giang	-	5000	5000	5000
16. Kien Giang	-	10000	10000	10000
17. Quang Nam	-	8000	10000	10000
	27500	70500	88000	100000

Note : Five new factories will be built up on next five years plan

UNITED NATIONS

Appendix 9

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

PROJECT IN VIET NAM 26 July 1985

JOB DESCRIPTION

DP/VIE/80/033/11-51/31.7.E

Post title: Consultant in tin can manufacture and testing

Duration: Six weeks (1.4 m/m)

Date required: As soon as possible

Duty station: Hanoi, with travel within the country

Purpose of project: To make a survey on the canning industry in Viet Nam.

Duties: The consultant will be exptected to:

1. Make a survey on the canning industry in Viet Nam, as regards its present status of development, actual needs projected requirements;

2. Review and assess the present operation systems in the Hanoi Canning Plant, regarding varnishing, can making and testing/drying (burning);

3. Elaborate a comprehensive technical assistance programme for the development of the food canning industry in Viet Nam, with special emphasis on the improvement of production and related introduction of testing and quality control of tin-plate, varnishes and varnished tinplate cans, both empty and with food contents. In this connection the following elements have to be prepared:

   - A project document for technical assistance to the Hanoi Food Canning Plant, with defined objectives, scope, expected outputs, activities, and required inputs;

.../..

Applications and communications regarding this Job Description should be sent to:
Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

V.31-33106

- A detailed training programme for national counterparts, in terms of fellowships for technical personnel and study tours for managers;

- Terms of reference for the consultants to be provided under the project;

- A detailed list of equipment with indication of possible suppliers for the different items;

- A detailed work plan with a logical time schedule for co-ordinated guidance of project activities implementation.

Qualifications: Expert in manufacture, varnishing and testing of tinplate cans for fruit preserves, with University degree or equivalent experience.

Language: French or English

Background information: The Hanoi Food Canning Plant produces various canned products such as pineapple juice (slices and chunks), orange juice, lychees, lemon juice, banana nectar, etc. There is one line for making tin plate cans, varnishing by spraying (blowing) varnish into formed cans and application of sealing compounds on can ends. The cutting shear and rollers do some damage to the surface of the tin plate. Varnish is applied into cans only once, which is followed by heating in a tunnel oven (furnace) at sufficiently high temperature; there is no regular testing of tin plate porosity, quality, varnish adherance, varnish resistance to various products, etc. Filling of cans is done by hand, addition of citric acid and mixing it with pineapple juice are also done by hand; pH is tested with pH solution-comparator. Seaming (can closing) machines are semi-automatic and each can is fed to the machine by hand.

The country has eleven food canning plants and the annual production was in the range of some 22,000 Tonnes of canned food products. They are faced with similar problems.