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EDITORIAL

During the first three years of the existence of the Division's Food Preservation Quarterly the continued expansion in numbers on the mailing list has been most gratifying to the Division and is welcomed as an appreciation of the work involved in the preparation of the wide range of articles already published. Throughout, the original aim of disseminating information which would be of practical value to food processors has been adhered to, since this was regarded as the most useful service which could be rendered to the food industries in these times. This policy will be adhered to in the future, but in addition it is proposed to increase the scope of the publication by the inclusion of material which may be useful in the education of food technologists. The tremendous increase in the wartime output of processed foodstuffs in Australia has focussed attention on the handicaps suffered by the food industries due to the lack of adequately trained personnel. The impetus given by the war is certain to be carried over into the post-war period when there should be a continuing demand for food technologists.

THE NEED FOR SCIENTIFIC RESEARCH IN THE CANNING INDUSTRY.

By L. J. Lynch.

Some years ago the late Sir T. Brailsford Robertson, one time Chief of the C.S.I.R. Division of Animal Nutrition, wrote among other things a small book which he titled "The Spirit of Research." In a discussion of the value of research this eminent scientist makes a strong plea for the universal recognition of the contribution to humanity of the work of scientific investigation. "To our shame," he says, "very few indeed have attained to the faintest realisation of the indubitable fact that we owe almost the entirety of our material environment, and no small proportion of our social and spiritual environment, to the labours of scientists or of their spiritual brethren." This sweeping indictment was prompted by a contemplation of the trivial material and financial resources allowed by society to those engaged in the solution of technical and scientific problems. Perhaps the reason for this state of affairs may be attributed to the modest demands of laboratory workers in the past. Our concern, however, is with the future and in particular with developments in the canning industry in Australia.

Research may be defined as laborious, careful inquiry, and when of a scientific nature, is undertaken by deduction from results of observed experimentation. It is to be clearly differentiated from the laboratory product control established in many of our commercial institutions. The latter usually involves the application of routine tests and is not the fundamental investigation which gives birth to progress. During the last decade and the war years in particular we have witnessed an unparalleled expansion of our cannery output in Australia. As late as 1940, technical research into canning problems was practically non-existent, and, while every endeavour has been made since then to cope with the flood of problems that have arisen, much yet remains to be done.

The early history of canning in U.S.A. is a record of tribulations and monetary losses. One unfortunate canner suffered severely from insomnia for the reason that the cannery was below his sleeping quarters and he was awakened frequently from slumber by intermittent explosions in the warehouse. The inevitable outcome of such difficulties was a universal recognition of the need for research. Canners banded together to form the National Canners' Association, the principal function of which was research into the problems with which the canners were beset. Difficulties were attacked in modest fashion by this organisation in its early stages, but with increasing vigour as funds and personnel permitted. The N.C.A., too, passed through a period of trial and for some time its fate swayed in the balance. To-day it has an enviable record and an unimpeachable reputation. Its activities have been extended to embrace legal interpretation of an ever increasing list of war regulatory measures as well as existing food and drug regulations, while it also assumes

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Up to the present, copies of the Quarterly have been made by duplicator and we wish to record our sincere appreciation of the very efficient manner in which this work, and also that of distribution, has been carried out by C.S.I.R. Information Section. Future issues will be printed and it is hoped that the new form will be favourably received by readers. Requests to be placed on the mailing list should be forwarded to the Secretary, C.S.I.R., 314 Albert-street, East Melbourne.

responsibility for contesting canners' liability cases at law. It controls the dissemination of authoritative technical literature wherein the findings of the Association are passed on primarily to its members, though in actual fact they find their way into the general literature in a very short time. Another important activity is that of statistical and market research and that by no means ends the list. In passing, it is our pleasing duty to record publicly the generous action of N.C.A. in extending to C.S.I.R. a courtesy affiliation for the duration of the war. As a result a large volume of technical information otherwise unobtainable has been released for the guidance of Australian Canners in their war effort.

In addition to N.C.A. the large can companies maintain research laboratories of generous proportions and an appreciable part of the technical contributions to the canning industry emanates from this source. The glass container industry is also playing its part together with manufacturers of cannery equipment, can sanitary enamel manufacturers and other industries closely associated with the production of canned foods. If in addition to all these we add a number of privately endowed institutions, universities and State colleges, and the resources of the United States Department of Agriculture, perhaps some idea will be gained of the substantial scientific backing that has helped to place the U.S.A. canning industry in the position of pre-eminence that it occupies to-day.

Let us contrast in a constructive way the picture just drawn with conditions as they exist in Australia at present. Prior to the war we canned quantities of fruit and meat products and perhaps a small amount of vegetable and fish. Since then, demands have increased by leaps and bounds until we have reached figures that might almost be regarded as astronomic. Despite lack of trained personnel and shortage of equipment, and in face of almost insurmountable obstacles, expansion of production has been tremendous. Now that we have almost reached the pinnacle we would be well advised to cast an eye over the last few years and learn what lessons there are to be drawn from them. Failures there have been in one direction or another, some of negligible proportions and some more serious. At a venture we would say that no canner, large or small, has been free from trouble, and difficulties still occur. Furthermore, future outbreaks of spoilage due to faulty processing or to post-processing contamination can be confidently predicted since we know that the industry has outgrown itself in two vital directions. The first of these has to do with technical control in the factory. By technical control is meant the application of existing knowledge in such a way as to ensure that a standard product will be canned under constant conditions. This can only be done by the establishment in the cannery of laboratory facilities under the supervision of a capable food technologist, that omniscient individual who combines a knowledge of the sciences of chemistry, physics, bacteriology and some degree of engineering in a highly specialised way.

The second and all important postulate is the provision of research facilities so essential for the winning of fundamental knowledge. The control technologist gives up when he no longer knows what to do next and it is at this point that the research laboratory comes into action. Canners in U.S.A. are not merely seized with the necessity for product control within the four walls of their factory. They appreciate in full measure the value of scientific research, and, having contributed in the past to the financial maintenance of bodies such as N.C.A., are now reaping the benefit. Perhaps it is too much to hope that Australian canners will unite in the near future to finance scientific research, but if something can be done to imbue individual canners with the need for research, then it is the first step in the right direction.

TINPLATE HAS A TEMPER.

By. L. J. Lynch.

One of the most striking advances of recent years in the canning industry in U.S.A. has been the standardisation of hardness or temper in tinplate used in the manufacture of food cans. Unfortunately, in Australia, this rather novel but most important metallurgical feature of modern tinplate was not appreciated when demands of war required that supplies be obtained from America. Can fabrication troubles due to "springy" plate were of common occurrence and, up to the present, these have not been entirely eliminated. Some explanation of the meaning of temper is, in consequence, likely to prove of value.

In the modern tinplate mill, huge iron slabs each weighing 11,000 pounds avoirdupois are hot-rolled to 14 gauge thickness, pickled to remove scale, cold reduced to 32 gauge and annealed. From the annealing stands the strip passes through the temper mill where, without any further appreciable reduction in gauge thickness, the hardness of the baseplate may be varied within certain limits. Further variation is possible by slightly altering the composition of the the raw material with respect to its phosphorus and copper content. By these means, tinplate is produced in tempers ranging from one to six. Plate of the same composition may be tempered from one to three by mechanical manipulation alone. On the addition of minute quantities of phosphorus, tempers four and five are also produced from the same plate.

Temper in tinplate may be determined by the use of the Rockwell Superficial Hardness Tester which consists of a diamond anvil and a 1/16-inch diameter ball penetrator. The sheet to be tested is laid on the anvil and the ball adjusted to touch the surface. A standard load of 30 kilograms is then applied and the depth of penetration is measured. Another machine for testing temper is the Olsen which works on the cup and ball principle. The load required to cup the tinplate to the point where it fractures is a measure of the hardness. A third instrument known as the Schaffer determines the resistance of the plate to bending. Conversion tables are available by means of which Rockwell, Olsen and Schaffer readings may be interpreted in terms of temper.

The application of the knowledge of temper in tinplate to the fabrication of cans is of the utmost importance. Heretofore when No. 10 cans were to be made, the heavyweight grade 107 or 112 automatically suggested itself. It is now recognised that temper is a more important factor in resisting retort stresses than weight. Likewise, can ends may require higher tempers than the tinplate from which bodies are fabricated. The following information indicates grades of plate to be used for different purposes:—

(1) Type L plate. Used for corrosive products.
  T4 (Temper 4)—Bodies and ends of No. 10 cans.
  T3 —Bodies and ends of No. 2½ and smaller cans.

(2) Type MR plate. Used for less corrosive products, *e.g.*, peaches, pears, and apricots. Tempers used are as in (1).

(3) Type MC plate. Used for vegetable, meat, and fish cans.
  T4 —Bodies of No. 10 and smaller cans.
  T4 —Ends of No. 2½ and smaller cans.
  T5 or T4—Ends of No. 10 cans, depending upon pressures generated during processing.
  T5 —Used only in bodies for No. 10 milk cans.

Tinplate of temper one is very soft and therefore suitable for deep drawing.

Type and temper are now being marked on every box of tinplate ordered in America for Australia so that it should be possible to select the right quality for every purpose in the near future.

THE CALCULATION OF THE COOLING LOAD FOR FOODSTUFFS.

2. FRUITS AND VEGETABLES.

By M. C. Taylor.

Fruits and vegetables are living materials and their respiration generates comparatively large quantities of heat. The heat produced by respiration decreases as the temperature is reduced, but it is appreciable even at cool-storage temperatures. This must be taken into account in calculating cooling loads for these materials.

Sensible Heat.

These foodstuffs normally have a high water content and for an approximate calculation of the cooling load, they may be regarded as mixtures of water of relatively high heat capacity and solids of low heat capacity.

For temperatures above the freezing point the heat capacity of the water content may be taken as 1 B.T.U. per lb. per °F., and the heat capacity of the solid content as 0.2 B.T.U. per lb. per °F. When the solids content is low, small variations in the latter figure will not affect the result appreciably. Treating the water and solids content of the foodstuff separately, we find per 1 lb. of the foodstuff that the cooling load in B.T. is equal to (weight of water per lb. of foodstuff) × (specific heat of water) × (change in temperature, °F.) + (weight of solids per lb. of foodstuff) × (specific heat of solids) × (change in temperature, °F.).

The heat load calculated according to this method is often called the sensible heat of the foodstuff, and is only part of the total heat which must be removed.

Heat of Respiration.

Since the ratio of heat generated to carbon dioxide liberated in respiration is very nearly constant, it is possible to calculate the heat of respiration (or vital heat) from data on the amount of carbon dioxide liberated in a given time, in which form the rate of respiration is usually expressed. There is a very wide variation in the respiration rates of different materials and accurate calculations are impossible without complete data. However, representative data for many fruits and vegetables are available from the literature and these are usually sufficient to indicate the maximum rates of respiration that might be expected. It will be necessary to allow for the rapid change in the rate of respiration which results from change in temperature. If sufficient data are not given to cover the working range of temperatures, an approximate law of variation may be used. This states that the respiration rate is doubled for every 10°C. (18°F.) rise in temperature. It follows that the rate of heat production at 86°F. is approximately eight times that at 32°F.

In the literature the rate of respiration is usually expressed as milligrams of carbon dioxide (CO_2) per 10 kilograms of material per hour. The appropriate rate of heat production in B.T.U. per ton (2,240 lb.) per hour may be found from this figure by multiplying by 10., *e.g.*, for apples at 32°F. having a respiration rate of 4 mg. of CO_2 per 10 kg. per hour, the rate of heat production is 40 B.T.U. per ton per hour.

Although the variation of respiration rate with temperature makes exact calculations rather difficult, there are some practical consequences which are worth noting.

1. The heat of respiration places a load on the refrigerating plant whether the temperature is being lowered or not. At the recommended storage temperatures this heat load may be beyond the capacity of the plant. The importance of loading fruits and vegetables into a store at the time of day when they are at their lowest temperature should be obvious. The loading of overheated material in a cold store not only places an undue load on the plant, but also has a bad effect on material already in store.

2. If large, close stacks are used, the rate of heat removal from the centre may be so small that the temperature will continue to rise and some of the goods may be spoiled. Some of the earlier cargoes of apples sent overseas were lost in this way.

Even where provision is made for ventilation throughout a stack, the temperature at the centre may continue to rise for some days, and it may take from 2 to 3 weeks to reduce the temperature of the bulk of the stack to 34°F. These troubles are not likely to be experienced in a land store which is filled gradually, and 2 or 3 days should be sufficient for cooling.

3. Rapid cooling of the goods reduces the load due to heat of respiration.

The following table gives aproximate values for the heat of respiration of some products at various temperatures:—

Product.	Temperature °F.	B.T.U. per ton (2,240 lb.) per 24 Hours.
Apples	32	740 to 1,000
,,	40	1,200 to 2,000
,,	60	5,000 to 7,500
,,	85	7,500 to 17,000
Pears (W.B.C.)	32	740 to 1,000
,,	60	10,000 to 15,000
Peaches	35	1,700 to 2,200
,,	60	7,500 to 15,000
,,	80	17,000 to 25,000
Oranges	40	1,500 to 3,000
,,	50	3,000 to 6,000
,,	70	4,000 to 9,000
Onions (Yellow Globe)	32	750 to 1,200
,, ,,	50	2,000 to 2,200
,, ,,	70	3,500 to 4,700
Potatoes (Cobbler)	32	500 to 1,000
,, ,,	40	1,200 to 2,000
,, ,,	50	1,200 to 1,700
,, ,,	70	2,500 to 4,000

THE INTERNAL PRESSURE TEST FOR FOOD CANS.

A DISCUSSION OF ITS RELIABILITY.

By W. A. Empey.

For most canned foodstuffs it is essential to prevent the entry of air or water into the closed cans after the products have been packed and processed. The entry of air or water into the cans will cause a loss of part or all of the existing vacuum and may bring about spoilage of the contents due to chemical changes or to the growth of contaminating micro-organisms.

The internal leakage-pressure test is commonly employed to test cans, either before or after packing and processing. There have been several reports received in this laboratory indicating that can-makers and canners both in Australia and in America have not always been able to demonstrate leaks in cans known to have lost vacuum or to have been spoiled by micro-organisms of post-processing origin.

In this article it is intended to recount the experiences of the C.S.I.R. Canning Research Laboratory in the testing of large numbers of cans by this method and to put forward possible reasons for its occasional reported failure. The points which will be discussed are:—details of the application of the method, results obtained with various groups of cans in this laboratory and a comparison of these with similar groups of cans tested by other organisations, the relationship between this and other methods for can testing, and finally the possible reasons for the failure of the method.

Details of the Method.

Our laboratory method for application of the internal pressure test has been described in detail in the Divisions Food Preservation Quarterly, Vol. 3, p. 7, but the details are of such vital importance that their description will be repeated in this article.

Cleaning the Cans.

In the case of cans which have not been packed with foodstuffs or which have held dehydrated products, cleaning of the cans or removal of the contents prior to pressure testing do not appear to be necessary. Our experience with the latter is, however, not very extensive and it is possible that seam leaks could be effectively blocked by small particles of dehydrated powdered products such as egg or milk.

In the case of cans which have contained moist foodstuffs a cleaning procedure is essential. The contents of the can are first emptied out through a circular opening at one end of the can. The remaining particles of food materials are then removed by thorough washing with hot water and brushing of the interior of the can. Where large numbers of cans are involved an effective method is to hose them out with hot water under pressure to dislodge food particles.

The cans are held for one hour in a tank containing boiling water. There is some advantage in having a continuous overflow of water from the tank and in keeping the water vigorously boiling, particularly in the case of cans which have contained fatty materials. It has been suggested that emulsifying agents might be used to facilitate the removal of fat, but in this regard it is inadvisable to use strongly alkaline substances because of the danger of damage to the rubber-containing sealing compounds used in the end seams of sanitary-style cans. The use of wetting agents which are effective in very low concentrations is, however, permissible.

Drying the Cans.

After boiling, the cans are drained and the water is shaken out as far as possible. The remaining water is then sucked out by means of a pipette or through a tube connected to a vacuum pump. The cans are dried in a hot air oven at 100°C. (212°F.) for one hour or at lower temperatures for longer periods. In this laboratory drying is usually carried out in a hot air oven (100°C.) with a forced air circulation. If lower temperatures are used it is very important to make sure that the drying time is sufficiently long to ensure complete removal of the water, both from the surface and inside the seams. It has frequently been proved in this laboratory that cans with leaky seams will be non-leaky when pressure tested immediately after rinsing the cans with a small amount of water, and will show leaks again only after thorough drying.

When tested on non-leaky cans the procedure outlined for cleaning and drying of cans proved non-injurious to soldered seams or to double seams containing the usual types of sealing compounds employed for heat processed cans, and did not cause them to be leaky.

Testing for Leaks.

The internal pressure test which actually determines the ability of the can to retain air under pressure is most readily demonstrated by immersing the cans in water, suitably introducing compressed air, and watching for the appearance of a succession of bubbles which will indicate an escape of air from the interior of the can. It is important to remember that there may be a small amount of air entrapped in the seams or on the surface of the can when it is immersed, but bubbles will not continue to rise from these areas.

With the type of pressure-tester used in this laboratory a rubber pad fits over the open end of the can, but when the simple puncture-type tester, which has no framework for holding the can, is used, it is necessary to solder a metal cap over the hole from which the contents have been removed. After taking the internal pressure up to 2 lb. per square inch, as indicated by a pressure-gauge attached to the equipment, the can is immersed in water and examined for leaks. The areas leaking at 2 lb. are marked and the pressure within the can is gradually increased to 5, 10, 20 and finally to 30 lb. and re-examined for leaks at each pressure level. The pressure to which cans can be taken without serious distortion depends upon the weight and temper of the inplate, the dimensions of the can, and the type of tester used. With the puncture-type tester, the approximate buckling pressures for different can sizes are given in the following table:—

Can No.	Dimensions (inches).		Buckling Pressure. lb./sq. inch.
	Diameter.	Height.	
10	6 3/16	7	10-15
2½	4 1/16	4 11/16	20
2	3 7/16	4 9/16	30
...	3 7/16	5 12/16	30
...	3 7/16	6 4/16	30

The buckling pressures are much higher in the tester which has pads which protect the can ends from undue expansion, Bubbles are more easily detected if the water bath in which the can is immersed is well illuminated. In this laboratory, cans which are puncture-tested are immersed in a cylindrical glass vessel of sufficient size to accommodate a No. 10 can, whilst in the other type of tester the interior of the metal tank is illuminated by means of light globes outside a glass window inserted in the bottom of the tank. Apart from the pressures at which leaks occur, the time taken for leakage bubbles to appear and the rate of their formation are noted. It has frequently been observed that the pressure must be held for at least 30 seconds before bubbles appear. In practice it has seldom been found necessary to hold the cans for longer than 60 seconds at any one pressure.

Laboratory Results.

During the past three years the internal pressure test has been applied to many thousands of cans in this laboratory, but it is intended to discuss here the results only for cans known to have become spoiled or to have lost vacuum as the result of the entry of air or water into the closed cans after processing. The cans included in these groups have been subjected to a wide range of conditions in processing, cooling, and subsequent storage. In some instances cans have been subjected to severe conditions during cooling and have been exposed to cooling water which was highly contamiated with micro-organisms. Care was taken to avoid the inclusion of cans which were visibly damaged or in which the ends had been permanently deformed as the result of high internal pressures due to gas production by spoilage micro-organisms.

The total number of cans examined in these groups has been approximately 1,200, including 900 spoiled by micro-organisms, and 300 showing loss of vacuum. Of these 1,200 cans, only 25 failed to show leaks after preparation and testing according to the procedure outlined, but the following fairly clear-cut reasons explained the failure of the test in these cases:—

Effect of Rusting.

In a series of 30 spoiled and blown cans most of which showed severe external rusting, 10 cans were found to be non-leaky, but a close examination revealed in each can that corrosion holes through the tinplate were blocked by particles of rust. The failure of the cleaning and drying to remove these rust particles is the probable explanation of the failure of the method.

Entrapped Food Particles.

In another series comprising 100 "blown" and/or low-vacuum cans, 15 failed to leak when first tested. After repeating the operations of cleaning and drying, 9 of the 15 leaked and a further 4 leaked after two or three more pre-treatments. In each can of the 98 which were leaky, the only areas of leakage were through the soldered side seams at, or close to, the junction of the side and end seams. It is reasonable to assume, therefore, that the two apparently non-leaky cans were similarly defective. Entrapping of food particles appears to be the probable reason for the failures at the first test in these cases, but such failures have not yet been encountered in the case of double-seam leaks. The reasons for this apparent difference in behaviour of soldered and non-soldered seams are not altogether clear, except on the assumption that food particles are more difficult to dislodge from the soldered areas.

In the majority of these 1,200 cans the leakage pressures were 10 lb. or lower per square inch, although in several instances pressures of 20 lb., and in a few cases of 30 lb., were recorded.

Comparison of Results.

In several comparative tests employing cans taken from the same batches of spoiled or low-vacuum cans our laboratory tests have disclosed 100 per cent. leaky cans even when other organisations have reported that less than 25 per cent. of the cans examined by them were leaky. It appears doubtful whether our laboratory procedure has been strictly adhered to in such cases.

Reasons for Failure of the Method.

From the foregoing discussion and from the evidence gained in examining the methods adopted elsewhere the most likely causes of failure, are, in approximate order of importance:—

(1) Insufficient drying of the cans before testing.
(2) Insufficient time allowed for the appearance of air bubbles.
(3) Failure to detect bubbles because of faulty illumination.
(4) Improper cleaning of the cans.
(5) Inability to detect all solder leaks.
(6) Rusting of corroded tinplate.

The first three of the above reasons are considered to be the most common in commercial practice.

Discussion.

With two exceptions in which solder leaks were suspected, the internal pressure test, as applied in this laboratory, has disclosed leaks in 1,200 cans known to have admitted air or water after processing. Whilst the test is a purely arbitary one, and while it is difficult to definitely prove that entry of air or water occurred through the leaky areas determined by the pressure test, there is good reason to believe that such has been the case.

This evidence does not support the theory that post-processing spoilage of canned foods may sometimes be due to the entry of air or water through can seams which prove to be non-leaky under the internal pressure test. Examination of larger numbers of cans may, however, be necessary to thoroughly test this theory, and particularly the possibility that minute amounts of air or water may enter cans during the period of cooling after heat-processing.

Amongst cans examined during the past three years there has been a fairly high proportion showing leaky seams under the internal pressure test, but in which there has been no clear evidence of the entry of air or water after processing. These cases can be accounted for by the sealing effect of either water or food materials in the seams.

Apart from obtaining evidence regarding the admission of air or water into processed cans, the internal pressure test has proved, in this laboratory, to be a valuable method for the assessment of can seams. In the majority of cases, seam leaks have been found to be associated with faults such as defective soldering, deficiency of sealing compound, or incorrect construction of cans and can seams.

The use of the internal pressure method for the testing of cans, with strict attention to all details, is strongly recommended to can-makers, canners, and all those engaged in the examination of canned foods. Some observations made in this laboratory during the past two years application of the internal pressure test to food cans received from various Australian canneries are recorded in the following three tables. Results given in Tables 1 and 2 were obtained from normal, apparently sound cans taken from canneries soon after the completion of processing. Less than 1 per cent. of these cans became spoiled on account of post-processing contamination during a holding period of approximately 12 days in this laboratory. The data in Table 3 was obtained from some of the outstanding cases of post-processing spoilage due to leaky cans which have come before our notice.

TABLE 1. Can leaks (10 lb. or less per sq. inch) due to canmakers faults.

Can-Maker.	Batches Examined.	No. of Cans.	Batches Showing Leaks.	No. of Leaky Cans.	% of Batches Leaking.	% of Cans Leaking.
1	14	47	Nil	Nil	Nil	Nil
2	220	540	9	9	4	1·6
3	27	277	5	9	20	4
4	16	66	3	3	19	5
5	54	282	12	19	22	7
6	18	97	5	8	28	8
7	16	90	6	7	37	8
8	9	46	5	7	56	15
Total ...	774	1,445	45	62	23	6

TABLE 2. Can leaks (10lbs. or less per sq. inch) due to canners faults.

Canner.	Batches Examined.	No. of Cans.	Batches Showing Leaks.	No. of Leaky Cans.	% of Batches Leaking.	% of Cans Leaking.
1	14	47	5	7	36	15
2	23	48	6	9	26	15
3	20	59	6	10	30	17
4	16	35	3	6	19	17
5	24	53	10	11	42	21
6	16	90	6	20	37	22
7	21	45	4	5	20	24
8	38	106	16	27	42	26
9	17	39	7	11	41	28
10	16	66	9	19	56	29
11	54	282	32	86	60	30
12	13	70	9	21	69	30
13	15	73	11	24	73	33
14	18	97	13	35	72	35
15	10	47	6	18	60	38
16	24	217	13	113	52	52
17	27	59	23	35	85	59
18	14	40	13	24	93	60
Total ...	380	1,473	192	481	51	31

TABLE 3. Spoilage due to leaky cans.

Canner.	Can-Maker.	No. of Cans.	No. of Spoiled Cans.	% of Spoiled Cans.	Can Leaks.			
					Maker's Faults.		Canner's Faults.	
					%	*Types.*	%	*Types.*
19	9	800,000	24,000	3·0	2·9	Defective soldering, embossing perforations.	0·1	Incorrect closing machine adjustments.
19	9	1,000,000	40,000	4·0		Defective soldering	0·2	„ „
19	9	50,000	23,000	46·0	46	Embossing perforations.	...	None found.
14	9	67,000	3,300	5·0	4·0	Defective soldering, incorrect closing machine adjustments.	1·0	Incorrect closing machine adjustments.
20	2	70,000	30,000	43·0	...	None found ...	43·0	„ „

The evidence from these tables shows firstly that a high proportion of the cans examined leaked under the internal pressure test, and secondly that high spoilage losses have been encountered in some lots of leaky cans. The possible reasons for the failure of leaky cans to become spoiled, even after the introduction of air or water into the cans, have been previously discussed in the Quarterly Vol. 3, No. 1 (1943). There is the further possibility that leaky areas are effectively sealed by food particles which prevent the entry of air or water. Only the cans which are non-leaky under the internal pressure test can be regarded as being free from the danger of post-processing contamination. For this reason, every endeavour should be made to reduce the numbers of leaky cans to a minimum.

ESTIMATION OF FILM WEIGHTS OF CAN-SEALING COMPOUNDS.

By W. A. Empey.

In order to maintain the dry film weights of can-sealing compounds within the range specified by the manufacturers of these materials, some means for checking these weights are necessary. Under ideal conditions, automatic filling machines commonly used for applying these compounds can be relied upon to deposit within plus or minus 5 milligrams of the intended dry film weight, *e.g.*, 90 mg. ± 5 mg. in a 401 end.

The equipment required for checking weights will depend upon the methods used and on the number of ends selected for examination. Balances required for weighing single can ends should be capable of giving accurate readings to the nearest milligram, but when a 100 or more ends are used, a balance which can be read accurately to the nearest tenth of a gram will be quite satisfactory. For routine checking, can ends either weighed singly to the nearest milligram, or in lots of 100 to the nearest tenth of a gram, are run through the lining machine and reweighed after drying.

A different procedure is necessary in the case of ends which have not been weighed prior to the application of compound. In some instances the dry compound can be scraped out and weighed. If the compound adheres very closely to the can ends the use of a strong ammonia solution will facilitate its removal. The particles of compound are heated to drive off the ammonia and weighed. Alternatively, the can ends may be weighed before and after the removal of compound. In the case of internally lacquered can ends some allowance may be necessary for lacquer removed during scraping, but this is not likely to exceed a few milligrams in a 401 end.

It is not absolutely necessary to dry the compound on the ends before weighing. Weighed ends may be taken immediately after lining and quickly reweighed to avoid undue loss of volatile substances. From a knowledge of the solids content of the particular compound, it is possible to calculate its dry film weight. By this procedure, results can be obtained from 10 to 20 minutes sooner than when the ends are oven dried.

Measurements of weights in closed double seams are much more difficult, but these have been made in this Division's laboratory by a slight variation of the usual method for stripping out end seams. The can is opened around the outer expansion ring and the end seam cut through with a pair of pincers. The bottom of the seam is then pulled out from the side of the can with a pair of pliers. This results in the body hook being pulled away from the side of the can so that it stands out from the body at an angle of about 90°. When the seam is stripped out in the usual way, the body and cover-hooks pull apart exposing the sealing compound. Narrow strips of metal with the attached compound are cut from the body and end respectively. After drying in a hot air oven to remove moisture these sections are weighed. The compound is then removed by scraping after softening with a strong ammonia solution. When the compound is completely removed, as indicated by examination under a lens, the sections are dried and reweighed.

A NEW CHARTER FOR THE CITRUS JUICE INDUSTRY.

By L. J. Lynch.

The citrus juice industry in Australia has been established almost overnight, and processors in the Mainland States deserve every credit for their patriotic efforts in a time of crisis. America is foremost in world production, but not even there has initial expansion been so rapid. Our troops and those of our Allies in the Pacific areas are now getting supplies of the canned product in reasonable quantity and we would like to end right here. However, we must face up to realities, which means that while quantity is all that we can wish, quality is definitely below par.

Up to the present time we could hardly expect our juices to measure up 100 per cent., but there is no reason to be discouraged. This laboratory has examined samples from every producer in Australia, not once but many times. The faults are quite apparent and the remedies well within our means. So let us go to it.

It is an old axiom that one cannot make a good product from poor material, which brings us right away to our first freedom—fredom from poor fruit. We know quite well that organizing fruit supplies to canneries has been an almost superhuman task, and it will still be difficult in the future. This is not a criticism of past administrative action, but we are prepared to say that processors cannot bring juice quality up to the mark unless there is a big improvement in the condition of fruit received on the factory floor. Is there any need to say more?

Pouring oil on troubled waters is an effective method of inducing tranquility under certain circumstances, but oil with citrus juice is synonymous with mental agitation. How many times have we been told that juice is bitter, rancid, terpenous, marmalady and stale but otherwise pretty good? Most of the troubles are due to quite small quantities of rind oil, and it can still happen even when the oil content is within the specified limit. We are not telling you anything new when we say that citrus oil gets into the juice during extraction and at no other point. Our experience shows that oil content is low when juice is recovered by the hand-reaming method. Most of the troubles come with the adoption of automatic equipment. As a preliminary to extraction in the latter procedure, the oil-bearing layer of the rind is removed by rumbling. The tendency here is to expose the soft spongy white albedo and this tissue picks up oil with great facility. This is the crux of the problem, and a little thought will suggest ways of mitigating the trouble. Firstly, use plenty of water in the rumbler especially in the initial stages. The idea of keeping the oil-water bulk to a minimum is praiseworthy from the point of view of oil recovery, but disastrous to quality in the juice, and after all the oil is the by-product which as such should receive secondary consideration. Even when correctly rumbled, the fruit still carries with it more oil than we care to have in good quality juice. The fact that citrus oils are volatile suggests a further remedy that is quite simple and very effective. Pass the fruit from the rumbler directly through a steam box and follow immediately with a cold water spray to reduce temperature as soon as possible. Those people who extract juice by hand-reaming will find it advantageous to hold the fruit for 2 or 3 days in airy bins. The storage period wilts the rind so that there is much less tendency for the oil cells to rupture when pressed on the reamers. If the fruit is soft when received at the factory, delayed storage is detrimental as it allows a period for mould development. Freedom from oil is the second item of the charter.

Air is introduced into juices mostly at the time of extraction. Some of it is dissolved but the greater part is occluded on tiny chromatophores and on small particles of pulp. Deaerators can and will remove all but a small residuum of air, but only if correctly operated. Once and for all the dome-type deaerator installed in Australia depends for its efficiency upon impact and the vacuum level. Many, many times, processors *have been told that juice must be drawn into* the deaerator at the same level. If it is drawn up fifteen feet or so, the force with which it hits the dome is greatly reduced and an unduly high amount of residual air will remain in the juice quite irrespective of the vacuum level. With respect to the latter, we must admit that in the early stages of development of the industry a vacuum pump from any source was a treasure even if it only pulled 22 or 23 inches of mercury. Now we are asking for 29 inches and we mean what we say. *This level means not only* a highly efficient pump, but one placed right alongside the deaerator so that a short inch pipe connection will result in minimum impedance to air flow. Thus number three of the charter becomes freedom from air.

The fourth and last freedom is freedom from lacquer troubles, and quite a few of us know to our cost just what that means. The effect of oily juice on lacquer is bad while the combined effect of oil and air is worse. We have always insisted that the best lacquered cans obtainable be used for citrus juices. *On the whole,* I think we have reason to be proud of our achievements in this direction too. Moreover, the immediate adoption of the latest American technique is likely to see a further substantial improvement in the near future. Still, always remember that no lacquer will successfully resist oil in citrus juice and the rest is up to you.

Speaking very seriously, we want to see the citrus juice industry survive in Australia when this war is finished. The orange juice habit for breakfast is a valuable nutritional aid and one that should readily be established if we look to our laurels. Concentrate on quality in valencia juice and you will be surprised *to find your product palatable not* only immediately after processing, but even when it has been held for twelve months or more.

Sydney: Alfred Henry Pettifer, Acting Government Printer—1944.