FILTRATION OF CREAM FOR BUTTERMAKING

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SUMMARY

An appreciable reduction of the amount of extraneous matter in butter, as reflected by routine tests for extraneous matter on samples examined in the laboratory, has occurred in Queensland butter factories. This has resulted from the use of cream filtration equipment in factories during the past two years. The paper reports investigations which resulted in satisfactory methods for the filtration of cream in factories. It gives details of experiments with nylon filter cloths of varying pore size and the filtration of cream, prior to and after pasteurization, with commercially available and improvised types of cream filtration equipment. Nylon cloth of 75–100μ pore size was practicable for factory conditions and better results were obtained by filtering cream before pasteurization.

I. INTRODUCTION

The use of nap filter cloth normally used for the filtration of milk is unsuitable for the filtration of cream as the cloth soon becomes fat-saturated and clogs.

In previous work carried out in Queensland (Crittall 1958), it was shown in a limited number of tests that extraneous matter could be removed satisfactorily from cream by filtration through nylon cloth. This work has since been extended to cover a wider range of filter types and varieties of filter cloth. Because of the effect of protein precipitates blocking the filters following pasteurization, a repositioning of the filtering equipment in relation to the other cream processing equipment has been examined.

II. METHODS OF FILTRATION

Much interest in the filtration of cream has been aroused within the butter industry in Queensland because of the introduction of export regulations requiring all cream to be filtered prior to manufacture into butter. This has resulted in many attempts to improvise filters which are cheap and easy to maintain. The work reported here has been concerned with three commercial filters, representing both stocking and plate types, and a number of improvisations which have been evolved in individual factories.

(a) Commercial Filters

A general description of both stocking and plate-type filters has been given previously (Crittall 1958). In the case of the stocking or chamber type, a modification has been made in one commercial type by incorporating a fine

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metal gauze strainer, situated before the filter, to effect removal of the coarser material. Subsequently, a further modification was introduced by the replacement of the gauze by a perforated stainless steel sheeting with perforations $\frac{1}{16}$ in. in diameter. The latter modification was carried out in an attempt to effect easier cleaning of the filter.

(b) Improvised Filters

Various types of improvised cream filters have been tried by many butter factories. These fall broadly into two types—a cloth stocking fitted over the end of a pipeline, and a cloth bag lining the inside of the cream balance tank. Whereas earlier these filters used a cotton cloth, the success demonstrated with nylon material soon brought about the discarding of cotton in favour of nylon for most stocking or bag-type filters.

Some of the improvised filters used in factories are shown in Figures 1–4. Figure 1 shows a large nylon bag lining the inside of the balance tank between the vacreator and the plate cooler in a Queensland factory. The area of this cloth is 11–12 sq. ft, and up to 4,000 gal of cream have been filtered without the material becoming too clogged to maintain an efficient throughput of cream. Where no such balance tank is used, as at factories which cool cream by means of a surface cooler, two nylon bags tied on the distributing line at the top of the surface cooler may be used. This device as used in a Queensland factory is shown in Figure 2. A rather more complicated device is being used at one factory in Queensland (Figures 3–5). To minimise the strain on the material, the nylon is supported in a metal gauze cylinder.

(c) Nylon Filter Cloths

Considerable attention has been paid to ascertaining the most suitable weave and mesh size of nylon for the efficient filtration of cream. In this regard, two factors are involved, namely, maintenance of desirable throughput without creating too high back pressure, and the removal of as much extraneous matter as possible. These two factors are inter-related in the choice of suitable cloth.

Initially, suitable nylon weaves could not readily be obtained in Australia, and six different screening cloths were imported from manufacturers in the United States and three from sources in the United Kingdom. In these cloths the mesh sizes varied from 20 μ to 120 μ, measured as the average width of the filtering opening in each. All but one were multifilament weaves.

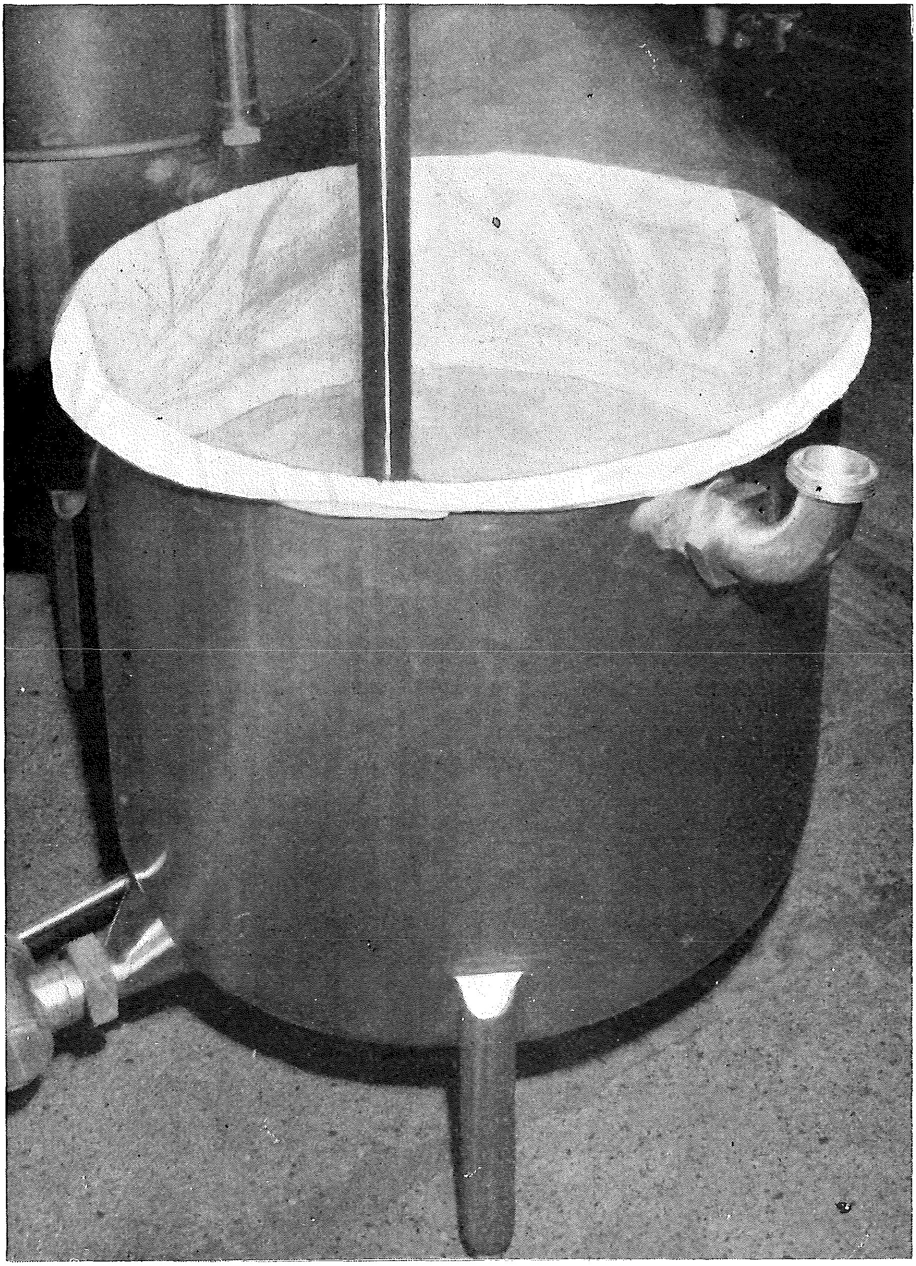

Fig. 1

Large nylon bag lining the inside of the balance tank between the vacreator and the plate cooler.

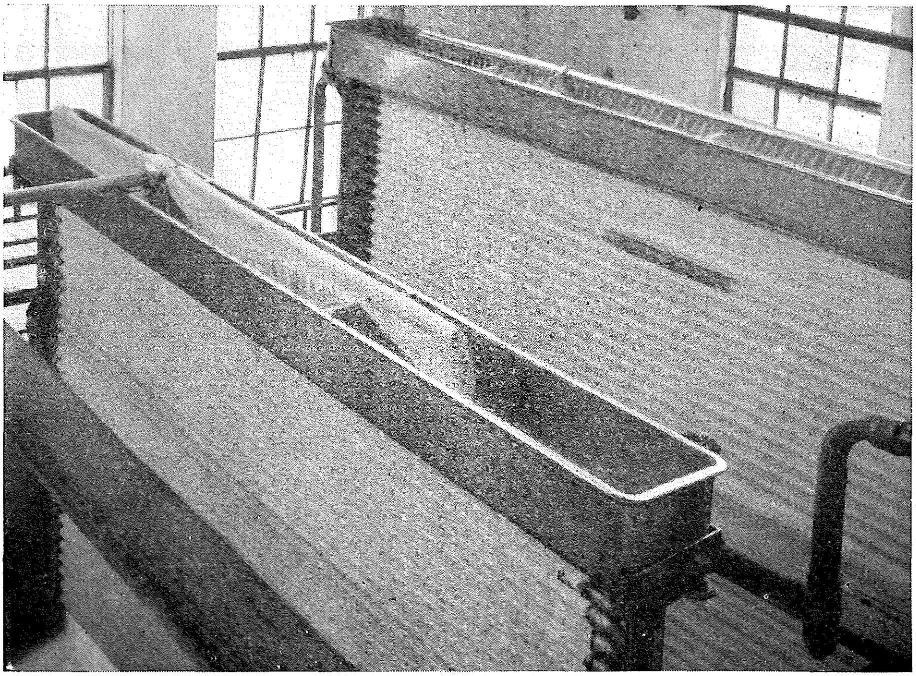

Fig. 2

Two nylon bags tied on the distributing line at the top of the surface cooler.

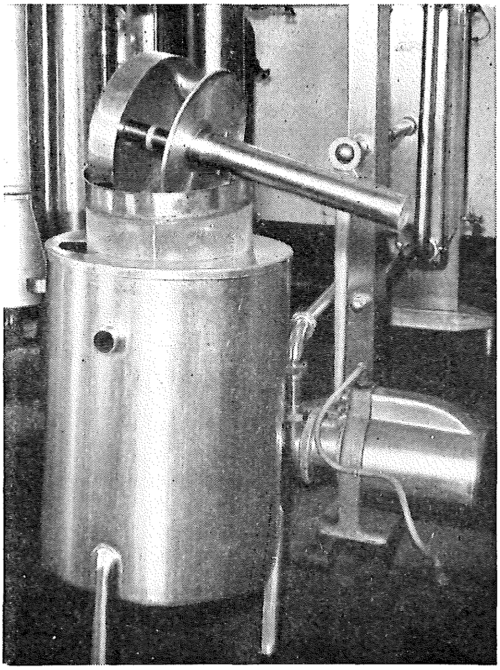

Fig. 3.

Showing support for nylon bag in balance tank.

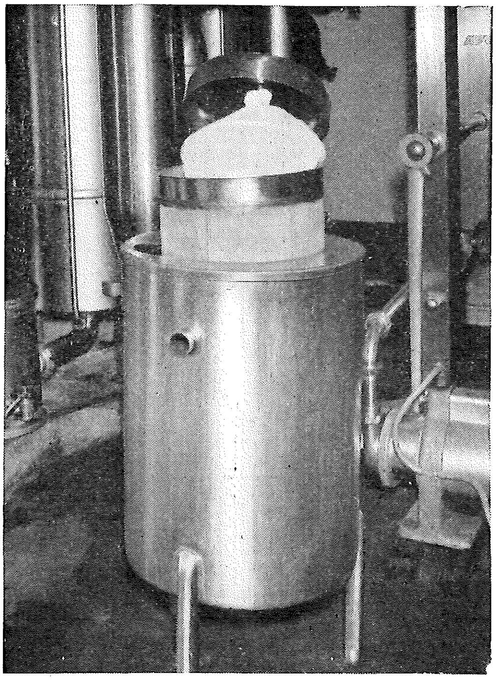

Fig. 4
Nylon bag attached.

From the point of view of efficiency of removal of extraneous matter, it would be expected that the finer cloths would be more suitable. Generally, this was found to be so, but the use of excessively fine pore sizes caused early clogging of the interstices with resultant low throughput and necessity for frequent changing of the cloths. Some materials procured locally and having pore sizes as high as 200 μ were also examined. These gave reasonably satisfactory results when the rate of sampling was not great. Where, however, the number of samples taken per churning of butter was increased, evidence of extraneous matter let-through was obtained. This raises the matter of the importance of sampling procedures in any work of this nature, a matter which is discussed elsewhere in this paper.

Results obtained in tests on butter manufactured from cream filtered through cloths of various pore sizes have indicated that a very small pore size is unnecessary for overall filtering efficiency. In this work three types of multi-weave cloths with approximate pore sizes of 40–60 μ, 70–75 μ, and 90–100 μ were used. After more than 500 tests had been carried out it became apparent that the efficiency of filtration with each of the three mesh sizes was not significantly different. The results indicated that a pore size as high as 100 μ

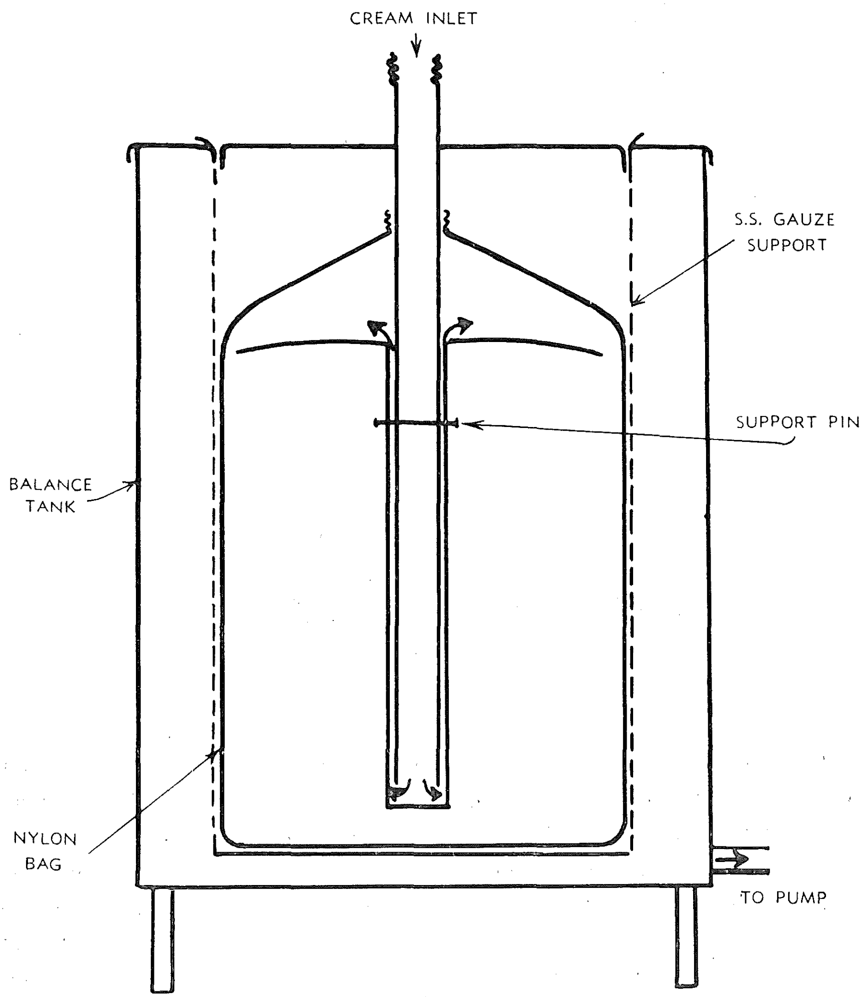

Fig. 5

Diagram showing how nylon bag is suspended in balance tank.

can be safely employed. With cloth of this pore size, a good throughput of cream is obtained. During this trial the frequency of sampling was kept approximately constant at the rate of one sample to each three boxes of butter manufactured, which is far in excess of the routine rate in testing laboratories of one sample per churn-load of butter.

III. POSITION OF FILTER

(a) Filtration After Pasteurization

Filtration of cream after pasteurization did not give entirely satisfactory results. There were a number of reasons for this.

In early trials with a stocking-type filter, installed between the balance tank and the cooler, so that the cream is filtered after pasteurization, considerable trouble occurred through breakage of the cloths. This was due to the fairly high pump pressures which resulted from clogging of the cloth itself. However, this was not always the cause of breakage of the cloths, because at times the nylon stocking was broken when bumped against sharp metal edges during careless assembly of a one-stocking-type filter. Breakage of cloths was more evident in this filter than in a plate-type or a double-stocking-type filter.

Observations made on the operation of stocking-type filters (40–60 μ mesh opening) used after the cream had been treated in a vacreator showed that filtration was satisfactory for a period of two to three hours; during this time approximately 1,000 gal of cream passed through one leg of the filter before a sock was changed. Then, rather suddenly, a blockage occurred, and on changing to a clean sock, instantaneous blockage of this sock also occurred. Sediment tests, using lintine filter discs, were attempted on cream sampled at this stage of processing. Normally, no difficulty was experienced in performing such tests, but with this cream it was impossible to force it through the filter disc. These blockages were due to the formation of a gelatinous substance during heat treatment of cream in the vacreator, and not to inefficient washing of the stocking. A coarser cloth (approximately 100–120 μ mesh) permitted a satisfactory flow rate of cream. As well as this gelatinous substance in the vacreated cream, scale-like residues were found on the filter cloths. Particles of this scale varied in size from a fine powder to small flakes about $\frac{1}{4}$ in. long and the quantity increased whenever cream was again treated after the vacreator was stopped for any reason.

As the amount of scale and dirt in the filter increased pressures were recorded on the pressure gauge attached to the filter, the differential pressure sometimes reaching 25 lb per sq. in. These pressures were excessive and could be responsible for forcing the fine scale into the pores of the filtering medium with resultant clogging or bursting. In order to reduce the pump pressure, the filter was still placed after the vacreator, but on the suction side of the pump rather than on the discharge side, as previously. In order to achieve this, the balance tank had to be raised about 3 ft and the filter placed in an almost horizontal position. With the filter in this position it was found that there was less fracturing of threads of the nylon socks, but, as would be expected, there was no improvement in throughput and, as a pressure gauge cannot be used here, it was difficult to judge when the sock was becoming clogged.

(b) Filtration Before Vacreation

In order to overcome these difficulties it was decided to place the filter before the vacreator and filter the cream before pasteurization. The cream filtered at this stage had been pre-heated either by means of a steam injector in the cream line between the neutralizing vats and the vacreator, or by steam introduced directly into the cream in the neutralizing vats. Although this latter practice cannot be recommended, the factory where this trial was performed has been pre-heating cream in this manner for several years without any apparent detrimental effects. It is thought that these methods of pre-heating could cause increased fat losses during the churning of cream, a matter which is being investigated.

The temperature of the cream after pre-heating was usually 105–110°F but varied from 80°F to 120°F. In the two factories where cream was filtered before pasteurization, pressure heads were fitted to the vacreators to enable high-temperature cream treatment.

Various nylon cloths with mesh openings of 40–60 μ, 70–75 μ, 90–100 μ and 150–200 μ were tried. Good throughput was obtained with all cloths in both plate and stocking-type filters. In one stocking-type filter tested, the effective area of cloth available for filtration varied from 2 sq. ft to 4 sq. ft, depending on whether the diameter of the sock was large enough for it to be supported by the exterior stainless steel perforated plate, which blanked off approximately 50 per cent. of the cloth. In this case, consistent runs of 1,000 gal of cream per leg were recorded when 40–60 μ mesh cloth was used, and with 70–75 μ mesh cloth it was possible to filter 2,000 gal of cream before a changeover of filter cloths was necessary. With a 24-plate commercial filter the effective filter area of cloth was 15 sq. ft, and using a cloth with a porosity of 75 μ, 4,000–5,000 gal of cream were usually filtered satisfactorily, although on one occasion when the cream was rather dirty, the maximum was barely 4,000 gal.

In some factories, where cream is filtered before pasteurization, a fine-gauze strainer is placed in the balance tank installed after the pasteurizer to collect the larger scale particles. At present 40-mesh stainless steel gauze is in use, but 60-80-mesh would not be too fine. Although the presence of such scale in the butter does not incur any penalty insofar as extraneous matter is concerned, it may have an effect on the bacterial development in the butter, and it is better removed. Regular inspection of the balance tank will reveal whether the filter cloth has become torn, as extraneous matter can then be seen floating on the cream in the balance tank.

IV. CLEANING OF CLOTHS

The nylon cloths have been most satisfactorily washed in the following manner: Rinse off excess cream with warm water, socks having been turned inside out. Wash in hot detergent solution by rubbing material against itself. Rinse in warm or hot water.

It was observed that nylon used in a filter positioned before the pasteurizer is more readily cleaned than that used in a filter after pasteurization. In the latter case, the cloths may appear clean, but a fine dust-like deposit is occasionally noticed after the cloth has dried out.

If cream is filtered after pasteurization, the filter cloths need to be sterilized by such means as soaking in a sodium hypochlorite solution (approximately 200 p.p.m.) and pre-filtration contamination must be avoided. This is not so important if cream is filtered before pasteurization.

V. RESULTS OF TESTS

Between January 1956 and March 31, 1959, over 6,000 routine tests for extraneous matter in butter were performed and the filter discs examined. The classification of Lawrence (1951) and a modification of his method were used for these tests. Figure 6 shows the percentage of butters in each quarter of the year which were classified as "dirty" or "very dirty". It will be seen that there has been a steady reduction in the quantity of extraneous matter found in butter, and there seems to be a seasonal factor associated with its incidence. The percentages of samples classified as "dirty" were highest in the April-June months. Most Queensland butter factories have installed some cream filtration device, and this action has been responsible for reduction in extraneous matter in Queensland butter.

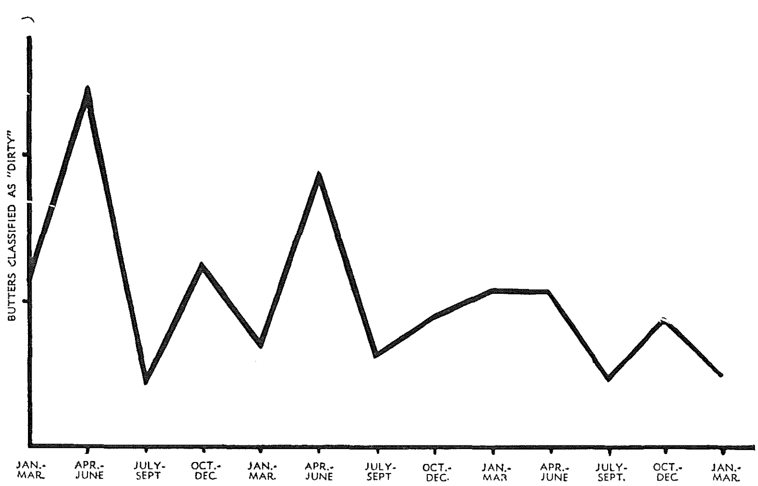

Fig. 6

Incidence of extraneous matter in butter, showing reduction since factories began to filter cream.

The results of tests made from 102 samples of butter during a period of 15 months from one factory where a nylon bag was fitted to the end of the pipeline in the balance tank placed after the pasteurizer were as follows:—

—	Clean	Fairly Clean	Dirty	Very Dirty
Number of tests	30	69	3	0
Percentage ..	29·4	67·9	2·9	0

VI. DISCUSSION

Results of over 6,000 extraneous matter tests made on samples of butters have shown that cream can be filtered satisfactorily to give a "clean" or "fairly clean" extraneous matter disc. The efficiency of filtration of cream naturally depends on the openness of the cloth used, and it has been found that nylon cloth of 75–100 μ pore size is most practicable. With commercial filters better results were obtained by filtration of cream pre-warmed to approximately 105°F prior to pasteurization. Some makeshift filtration devices are satisfactory, provided the nylon sock or bag is supported in some way; otherwise, there is a greater risk of the material bursting.

The sample of butter taken for the extraneous matter test is only 15 g, a very small quantity in comparison with that produced from a churning of butter, which may be as much as 2½ tons. It is realised, however, that in the case of export butter the size of the sample which can be taken is limited. This should be borne in mind when an extraneous matter test of butter is being made, and a decision on its classification by the extraneous matter test would be better based on results from a series of tests rather than on an individual test.

VII. ACKNOWLEDGEMENTS

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