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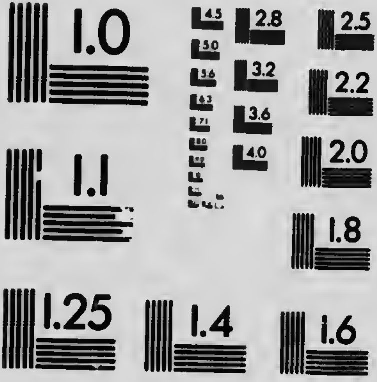

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DEPARTMENT OF AGRICULTURE
DAIRY AND COLD STORAGE BRANCH
OTTAWA - - CANADA

Cold Storage for Creameries

WITH PLAN AND SPECIFICATIONS

BY

J. A. RUDDICK
Dairy and Cold Storage Commissioner

Bulletin No. 36
Dairy and Cold Storage Commissioner's Series

Published by direction of the Hon. Martin Burrell, Minister of Agriculture, Ottawa, Ont.

FEBRUARY, 1913

34876—1

LETTER OF TRANSMITTAL.

OTTAWA, January 20, 1913.

To the Honourable
The Minister of Agriculture.

SIR,—I have the honour to submit for your approval the manuscript for a new bulletin on the subject of Cold Storage for Creameries.

I have the honour to recommend that the manuscript be published as Bulletin No. 36 of the Dairy and Cold Storage Series.

I have the honour to be, sir,

Your obedient servant,

J. A. RUDDICK,

Dairy and Cold Storage Commissioner.

COLD STORAGE FOR CREAMERIES

WITH PLAN AND SPECIFICATIONS

BY

J. A. RUDDICK

INTRODUCTION.

Butter is at its best when freshly made. Strictly speaking, deterioration begins once, and it will become noticeable sooner or later according to the conditions der which the butter is kept. The most important condition in this respect is that temperature, because no other condition has anything like the same influence in preservation of butter. The preservation of butter is effected by checking to a ater or less degree those processes of fermentation, which eventually destroy its flavour. Temperatures below zero have been employed for long storage of butter, t it has never been found that even such extremely low temperatures will preserve flavour indefinitely. Generally speaking, the lower the temperature the longer ll the butter be preserved, other things being equal. There is, of course, a certain riod in the life of all good butter, during which it may be considered to be at its t. Assuming that the butter has been well made, the duration of this period pends almost entirely on the temperature at which the butter is kept. All other siderations fade into insignificance compared with it. It follows then, that the gth of time that may elapse between the manufacture of the butter and the date its consumption should be the principal guide in determining the temperature that st be ployed to secure the best results.

B akers and creamery managers sometimes argue that as they can dispose the butter to the merchants or dealers before the deterioration amounts to a fference in price, it does not pay them to provide efficient cold storage at the eameries. Even if this were true, which it is not, it would be a very shortsighted licy, and the person who holds such views, and acts accordingly, is not doing his t in the interests of the farmers who produce the milk. He overlooks the fact that is the condition of the butter when it reaches the table of the consumer that termines the ultimate price.

Every creamery should have a cold storage in which the temperature can be intained as low as thirty-eight degrees or lower, but even then the butter should shipped as quickly as possible to a warehouse where it will be cared for at a much wer temperature.

The cost of building a good creamery cold storage, and the lack of accurate formation on the subject of insulation, have militated to some extent against the cessary improvement.

It was with a view of providing some reliable information of this kind, that a ries of experiments was recently planned by the Dairy and Cold Storage Commisoner for the purpose of determining the relative efficiency of various materials, and combinations of materials, for the insulation of ice chambers and cold storage compartments. The experiments were not intended to be exhaustive, but simply to cover the use of such materials and plans as are likely to be used in the construction of creamery cold storages in this country. It is not proposed at this time to set forth in detail the data that have been collected as a result of this work,* but simply to make a few recommendations based on the conclusions drawn from the experiments, coupled with the experience gained in watching the results secured at numerous creamery cold storages throughout the country.

Mechanical refrigeration is indispensable where low temperatures are required as in a modern cold storage warehouse, and it may be employed with advantage in creameries having a large output of butter. For small or medium sized creameries, however, the first cost of installation, and the annual expense of operation, put the mechanical system out of the question. For that reason, a great majority of the creameries in Canada will continue to use ice as a refrigerant.

After watching the results at several hundred creameries, where bonuses have been paid by the Department of Agriculture on cold storage of varied construction and of different systems, the officers charged with the administration of the payment of creamery cold storage bonuses have reached the conclusion that the best system for creamery purposes is what we have called the Circulation System.

THE CIRCULATION SYSTEM.

Although it is possible to secure rather lower temperatures with the cylinder or tank system, using crushed ice and salt, than can be obtained with the air circulation or gravity system, our experience is that a lower average temperature is usually found where the air circulation system is in use.

In any system which requires the renewal of the ice supply from time to time, its successful operation depends on the interest and industry of those in charge, and our experience is that the matter of refilling the ice boxes is very often neglected.

In the circulation system both the Ice Chamber and the Refrigerator are fully insulated, or in other words, the covering of sawdust or other material with which the ice is surrounded in an ordinary ice house, is made permanent by being added to the construction of the building.

SPECIFICATIONS FOR THE CONSTRUCTION OF A SMALL COLD STORAGE. CIRCULATION SYSTEM.

General.

A cold storage on the circulation system consists of:—

1. An insulated chamber in which a season's supply of ice is stored without covering of any kind.

2. A cold room, or Refrigerator, for the storage of such goods as it may be desired to protect from the deteriorating influence of a high temperature.

3. It is an advantage to provide an Ante-room to the Refrigerator, which helps to prevent loss of cold air when the door of the Refrigerator is opened. It may be

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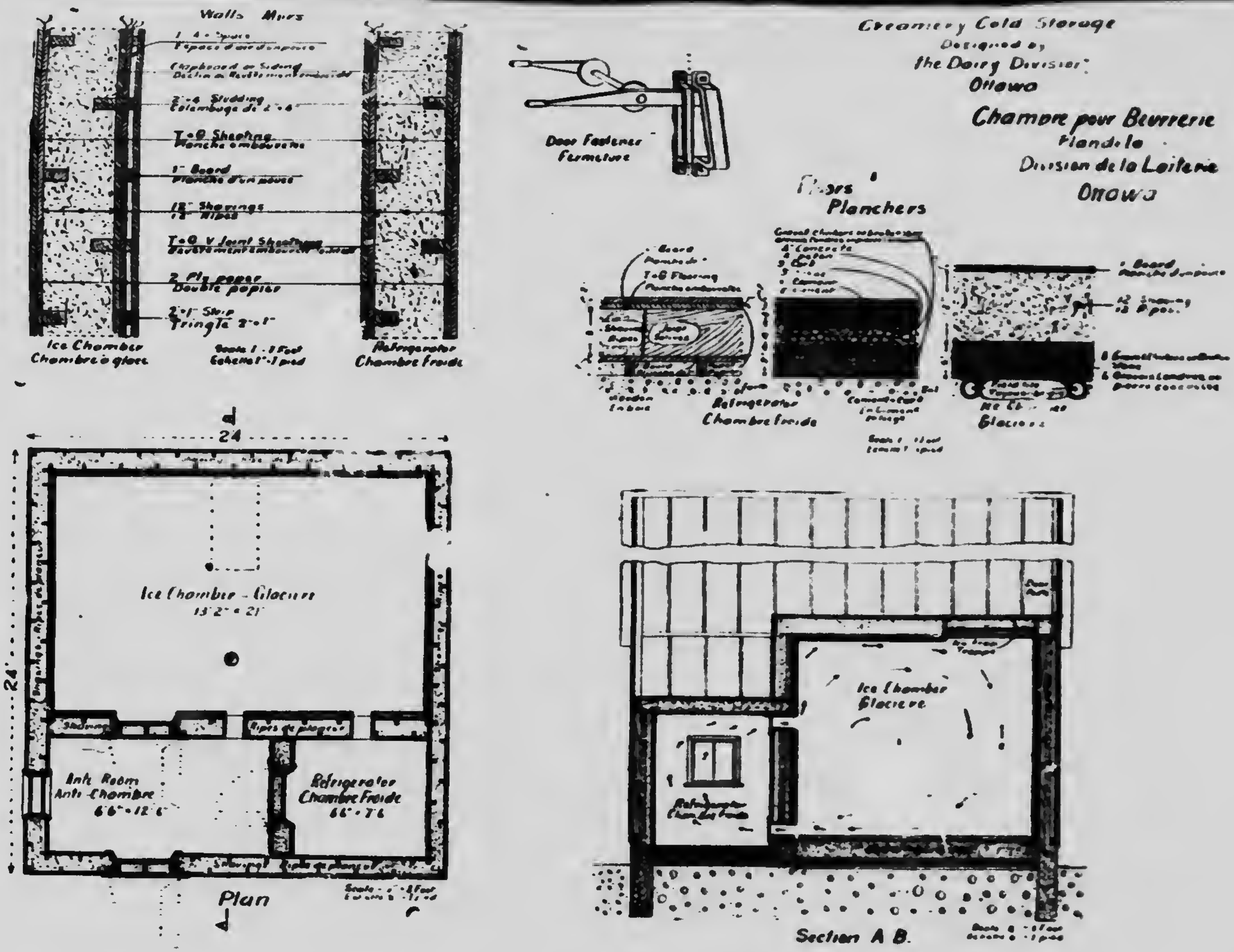
* NOTE.—Full details of the experiments are given in the Dairy Commissioner's Report for 1906.


Creamery Cold Storage
Designed by
the Dairy Division,
Ottawa
Chambre pour Beurrerie
Plan de la
Division de la Laiterie
Ottawa
Walls Murs
Clapboard or Siding
2×6 Studding
Colombage de 2×6
T+G Sheeting
Planche embouvetée
1" Board
Planche d'un pouce
12" Shavings
12 Pipes
T+G V Joint Sheeting
2 Ply paper
Double papier
2×1" Strip
Tringle 2×1"
Ice Chamber
Chambre à glace
Refrigerator
Chambre Froide
Door Fastener
Fermeture
Floors
Planchers
Board
T+G Flooring
Refrigerator
Chambre froide
Ice Chamber
Glacière
24
Ice Chamber - Glacière
13'2" × 21'
Ante Room
Ante-Chambre
6'6" × 12'6"
Refrigerator
Chambre Froide
6'6" × 7'6
Plan
Ice Chamber
Glacière
Section A B.

used for temporary storage of retail butter, and it serves as a suitable place in which to print butter during hot weather.

Best Situation.—A creamery cold storage should, if possible, be placed on the north side of the creamery, and sheltered from the direct rays of the sun.

Size.—The size of the cold storage will depend on the quantity of butter manufactured weekly. It is not desirable to provide for more than a week or ten days' output.

The ceiling should not be over seven feet high. A room eight feet square will store 120 boxes of butter if piled six feet high.

Light.—It is best not to have a window in the Refrigerator. A window may be put in the Ante-room if double sash is used and the direct rays of the sun excluded. The window should be placed opposite the door between the Ante-room and the Refrigerator, so as to give light in the latter room when the door is open.

Materials.

Wood.—All lumber employed must be thoroughly dry and sound, without loose knots or shakes, and must be odourless.

Spruce and hemlock are the best, in the order named. Pine is not suitable for inside sheathing on account of its odour.

All lumber used should be dressed as well as tongued and grooved.

Unseasoned lumber must be carefully avoided. When building in winter, fires must be kept going so as to have all materials as dry as possible. This is very important, as dampness in insulation destroys its efficiency.

Paper.—All building papers used to be strictly odourless and damp-proof.

Damp-proof insulating papers can be procured in rolls of 500 to 1,000 square feet, 36 inches wide. The following are some of the brands that can be recommended, viz.: "Neponset," "Hercules," "Ko-Sat."

Tar paper, felt paper, straw paper, rosin sized paper, and all other common building papers are not suitable and must not be used.

Use double thicknesses of paper in all cases, each layer lapping four inches over preceding one. The layers should extend continuously around all corners. All breaks to be carefully covered.

Shavings.—Shavings must be thoroughly dry, free from bark or other dirt. Shavings from some odourless wood, such as hemlock, spruce or white wood, to have the preference.

Shavings in compressed bales, weighing from 60 to 100 pounds, may be procured from the following firms: Wm. Rutherford & Sons Co., Montreal; J. & G. Esplin, Box Manufacturers, Montreal; The Capital Planing Mills, Ottawa; The Firstbrook Box Company, Limited, Toronto.

Bales of shavings received in a damp condition should be opened, and the shavings exposed to the air and stirred occasionally until they are dry.

The spaces in the walls should be filled as the inside sheathing is being put on, and the shavings thoroughly packed.

Cinders.—Coal cinders should be used wherever possible to cover the earth over area of Refrigerator in preference to sand or gravel.

Construction.

Foundations.—The foundations should be of stone or concrete, fourteen inches thick and two to three feet deep, according to the nature of the site.

Floor in Ice Chamber.—The area of the floor in the Ice Chamber should be graded with a slope of three inches to one corner. Lay rows of field tile three feet apart leading to the low corner and connect same to the drain outside the building. The connection should be trapped to prevent passage of air. Cover the tile with eight inches of coal cinders. If cinders are not procurable, clean gravel may be used. On top of cinders or gravel, lay loose boards. This forms the permanent floor of the Ice Chamber and provides drainage for the melting ice.

Floors in Refrigerator and Ante-room.—These floors may be made in one of the following ways:—

1. Lay four inches of concrete over area of floors. On top of this, lay three inches of cork board and finish with one inch of cement. (See detail drawing.)

2. Cover area of floor with six to eight inches of coal cinders or dry sand or gravel. Lay a ⅞″ tongued and grooved floor on 2″ x 4″ joists. Cover with damp-proof building paper and then place 2″ x 6″ joists at 24″ centres. Fill space between joists with planing mill shavings and cover with 1¼″ flooring tongued and grooved. (See detail drawing.)

Note.—The concrete cork board floor is much the best and being of permanent construction will be the cheapest in the end.

Walls of Ice Chamber, Refrigerator and Ante-room.—Erect two rows of 2″ x 4″ studs, "staggered," so as to leave a space of 12 inches between the inside and outside sheathing to be filled with shavings. Cover the outside with one course of ⅞″ tongued and grooved lumber (spruce preferred), two ply of felt building paper, and finish with siding or clapboards uniform with the creamery building. Cover the inside of the studs with two courses of ⅞″ tongued and grooved *spruce* sheathing, with two ply of *damp-proof* paper between. On the inside of the Ice Chamber only erect an additional course of ⅞″ tongued and grooved *spruce* sheathing on one inch furring strips so as to leave a one inch air space. This will check the moisture from the ice and thus preserve the wall and insulation from decay.

Ceilings.—Erect 2″ x 8″ joists at 24 inch centres. Cover under side of joists with two courses of ⅞″ tongued and grooved *spruce* sheathing, with two ply of *damp-proof* paper between. Finish ceiling of Ice Chamber with an additional course of ⅞″ tongued and grooved *spruce* over one inch furring strips, same as specified for walls of Ice Chamber.

Partitions.—Partition between Ice Chamber and Ante-room, and between Ice Chamber and Refrigerator, to be constructed in the same manner as the outside walls. Partition between Refrigerator and Ante-room to be constructed with 2″ x 6″ studding covered on both sides with two courses of ⅞″ tongued and grooved *spruce* sheathing with two ply of felt paper between.

Doors.—The doorway into Ante-room and the doorway between Ante-room and Refrigerator to be fitted with bevelled frames, as shown in plan. Make the doors bevelled to fit frames, with two courses of ⅞" *spruce* sheathing both inside and outside with a 4 inch space filled with shavings, these doors to have an opening 6' x 2' 6" clear.

The door from the Ante-room into the Ice Chamber to be of same construction as other doors, with an opening 4' x 2' 6" clear. The bevelled faces of all doors to be covered with felt to make as nearly as possible an air-tight joint.

Window.—Make a window 2' x 2' in Ante-room opposite the door into the Refrigerator so as to allow some light to enter the Refrigerator when the door is open. The window to be fitted with double sash well battened.

Openings for Air Circulation.—Make two openings, each 18" x 6" in the partition between Ice Chamber and Refrigerator. Place one opening at the ceiling of Refrigerator and the other near the floor. Fit each opening with a sliding cover. Make two similar openings 12" x 6" in partition between Ante-room and Ice Chamber.

Inside finish.—The whole interior of the Ice Chamber, Ante-room and Refrigerator should be given a coat of boiled linseed oil. The Ante-room and Refrigerator should be finished in hard oil varnish or whitewash.

Put no ventilator in the Ice Chamber, Ante-room or Refrigerator.

Notes.

The Circulation System.—Plate I shows plan and section of a creamery refrigerator on the circulation system. It will be seen that there is a connection between the two rooms which provides for the circulation of air over the ice and through the Refrigerator and Ante-room. The working of such a cold storage is automatic, and requires only to be regulated by the opening and closing of the slides that control the circulation of air. The ice is not covered, as the thorough insulation of the walls of the Ice Chamber is depended on to prevent undue waste of ice. Considering the two systems in the light of our present experience, we recommend the air circulation system for Canadian creameries.

Filling the Ice Chamber.—Before filling the Ice Chamber, lay about ten inches of planing mill shavings or sawdust over the permanent floor of the Ice Chamber and cover with loose boards. This layer of insulating material can be renewed when it shows signs of decay or mustiness. Pack the ice closely against the sides of the Ice Chamber.

Insulation.—Refrigerating engineers have during the last few years practically discarded the empty space—the so-called dead air space—once extensively used for insulating purposes. Theoretically, a dead air space is a poor conductor of heat, but the ordinary air space is not a dead air space. As one side of the space becomes warmer than the other, the air immediately in contact with it becomes lighter on account of the increase in temperature, and at once ascends, while colder air from the other side takes its place. Thus we have a circulation of air within the space and heat is carried from one side to the other by convection.

Moreover, it is extremely difficult to get the work done properly when empty spaces are depended on for insulation. The slightest crack or opening, even a nail hole, tends to destroy the efficiency of this form of construction.

In the insulation of wooden walls, the best practice at the present time provides for an outer and inner shell, as nearly as practicable impervious to air and dampness, with a space between to be filled with some non-conducting material. The width of the space will depend on the filling to be used and the temperature to be maintained in the storage room.

For a creamery cold storage constructed of wood, there is no better material for filling spaces than planing mill shavings. Where available at all, they are cheap; they are elastic and do not settle readily; but most important of all, they can be obtained in a very dry condition, which is essential, and, further, they do not absorb moisture readily after being placed in position. There may be some difficulty in obtaining a sufficient supply of shavings in places remote from manufacturing centres, but many of the large sash and door factories now pack shavings in bales, weighing about 75 pounds each, for convenience in shipping. The weight of shavings required to fill a given space will depend somewhat on the kind of wood from which they are made, and also to some extent on how tightly they are packed, but a fair average is from seven to nine pounds per cubic foot of space. They should be packed sufficiently to prevent future settling.

Sawdust vs. Shavings.—Because it costs little or nothing and is readily available in most country districts, there has been a tendency to use sawdust for filling spaces in the walls of small cold storage buildings. It is, however, far from being a satisfactory material for this purpose. In the first place, as sawdust is cut from green timber, it is always more or less damp and is, therefore, not a good insulating material. The dampness not only conducts heat, but it encourages the growth of mould and rot, first in the sawdust itself, and then in the walls of the building. As a result of the mould, the air in the storage room becomes musty and thus injurious to the quality of butter stored therein. The settling of the sawdust, caused by the growth of mould and consequent heating, leaves open spaces, which further weakens the insulation. In the experiments already referred to, we found by actual test that shavings are very much superior to sawdust for insulating purposes, apart from the objection to the sawdust on account of the mustiness which nearly always appears in rooms where it is used as a filling in the walls. If it is found impossible to procure shavings, sawdust is probably the next best material if it is well dried before being used.

Insulation must be dry.—One of the problems in cold storage construction is to provide against moisture being absorbed by the materials composing the insulation. Moisture or dampness may come from the outside air or from the goods in storage. It must be understood that dampness, as referred to in this connection, does not imply the presence of water in the ordinary sense, but simply the presence of moisture as we find it, say, in green lumber as compared with dry or well seasoned lumber.

In a wooden wall filled with shavings, it is the shavings which must be protected from dampness. This can be done by using damp-proof building paper between the two courses of sheathing, or boarding, both on the outside and the inside of the walls.

Brick or cement concrete absorb moisture readily, and unless they are given some special water-proofing treatment, the insulating quality of such a wall is rather low. The outside surfaces of brick walls may be painted with some effect, but where shavings are to be used inside of brick or concrete, the inner surface may be coated with pitch, paraffin wax, or some of the patented coatings on the market. Coating walls with either pitch or paraffin in cold or even cool weather without special apparatus is a rather difficult operation, on account of the tendency of both substances to harden very quickly. In using pitch, care must be taken not to get tar, or any mixture of tar, which would be ruinous on account of its odour. Pitch is odourless when it hardens. If the inside surfaces of brick or concrete walls cannot be properly waterproofed, the next best plan is to put one-inch furring strips on the wall, then one course of matched lumber, which will form the inside surface of the space to be filled. It will be all the better if the sheathing is covered with damp-proof paper.

The one-inch air space shown in the detail on Plate I is placed there for the purpose of stopping the moisture which comes from the ice. The furring strips and one course of boarding, which form this space, should be put on independent of the other sheathing, so that it can be renewed when, in course of time, it may have rotted owing to the dampness from the ice.

Size of Ice Chamber.—It is impossible to lay down any rule as to the total quantity of ice required for creameries with a given output, as so much depends on what the ice is used for, and also on the nature of the water supply. In many creameries, where there is an ample supply of cold water, no ice is used for cream cooling, while in others a large quantity is required for that purpose. If a pasteurizer is used, the extra cooling required increases the consumption of ice very considerably. It is important, however, to estimate correctly the size of ice chamber required for a cold storage on the circulation system. Where the circulation system is installed, it is best to have the supply of ice for cream cooling purposes kept separate from the cold storage supply. The ice chamber should not be opened more often than is absolutely necessary during the hot weather. The quantities given in the following table will be found to be about right for average circumstances:—

Pounds of Butter made during Summer Season.	Tons of Ice required for Butter Storage only.	Size of Ice Chamber in Cubic Feet.
200,000 Lbs.	140 Tons.	5,000 Cubic feet.
100,000 "	80 "	3,000 "
50,000 "	50 "	2,000 "

Where ice is required for cream cooling purposes, and it generally is, about one-half the quantity given in the table will be required in addition. This can be stored in an ordinary ice shed and covered with sawdust.

The Ice Chamber as shown in Plate I is large enough to permit of some ice being used for cream cooling and other purposes.

Recommendations.

In the light of experience, both experimental and practical, we recommend the Circulation System for Canadian creameries. We further recommend the construction shown in Plate I. In advising this form of construction, we take into consideration (1) the duty required, (2) the availability of certain material, and (3) the class of workmen usually employed on creamery construction. There are several special insulating materials on the market, but most of these require the services of experienced men for proper erection. The construction recommended in these pages is probably the cheapest efficient plan that can be devised, and it has the further merit of being easy of erection.

Note.—Blue prints of the plan in this bulletin, on a working scale, will be supplied free of charge on application to the Dairy and Cold Storage Commissioner, Ottawa.