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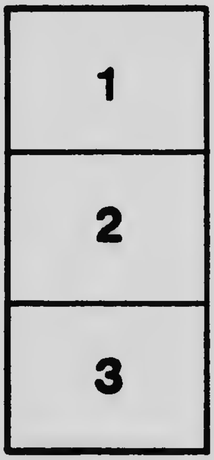
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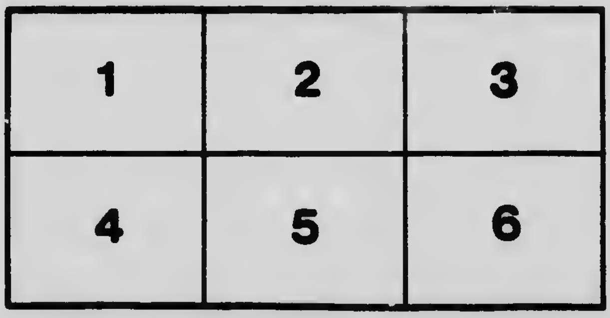
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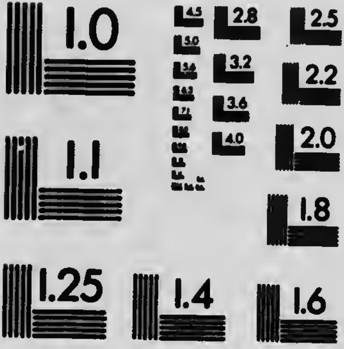

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DEPARTMENT OF AGRICULTURE
DAIRY COMMISSIONER'S BRANCH
OTTAWA, CANADA

CREAMERY COLD STORAGE

BY

J. A. RUDDICK,
Dairy Commissioner.

BULLETIN No. 10.

DAIRY COMMISSIONER'S SERIES

Published by direction of the Hon. SYDNEY A. FISHER, Minister of Agriculture, Ottawa, Ont.

MARCH, 1906.

DEPARTMENT OF AGRICULTURE
DAIRY COMMISSIONER'S BRANCH
OTTAWA, CANADA

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CREAMERY COLD STORAGE.

By J. A. RUDDICK.

LETTER OF TRANSMITTAL.

To the Honourable

The Minister of Agriculture.

Sir,—I have the honour to submit for your approval, Bulletin No. 10, Dairy Commissioner's Series, entitled 'Creamery Cold Storage.'

This bulletin is intended to supply a demand for information which comes from creamery owners, concerning the construction and management of creamery cold storages. Much advancement has been made in knowledge concerning cold storage during the past few years, and especially in that branch of the subject which deals with insulation. The plans and recommendations of a few years ago can now be considerably revised, and in some respects to the advantage of the builder.

The data secured from the results of recent experiments conducted by this branch of your department, with various materials and combinations of materials, used for the purpose of insulation, enable us to recommend a rather cheaper, and simpler, construction than has hitherto been considered advisable. We hope thus to encourage much improvement in the cold storage at Canadian creameries. The importance of efficient cold storage at our creameries cannot be over-estimated.

I beg to recommend that this bulletin be printed for general distribution.

I have the honour to be, sir,

Your obedient servant,

J. A. RUDDICK,
Dairy Commissioner.

Ottawa, Ont., March 15, 1906.

CREAMERY COLD STORAGE.

(By J. A. Ruddick.)

INTRODUCTION.

Butter is an unstable product. It is at its best when freshly made. Strictly speaking, deterioration begins at once, and it will become noticeable sooner or later according to the conditions under which the butter is kept. The most important condition in this respect is that of temperature, because no other condition has anything like the same influence in the preservation of butter. The preservation of butter means the checking to a greater or less extent of the processes of fermentation that affect the flavour, and which are inevitable in all butter. Temperatures below zero have been employed for the keeping of butter, but it has never been found that even such extreme low temperatures will preserve the flavour indefinitely, although it has been proved beyond any doubt that the lower the temperature the longer it will be preserved, other things being equal. Fortunately, there is a certain period in the life of all good butter, during which it may be considered to be at its best. Assuming that the butter has been well made, the duration of this period depends almost entirely on the temperature at which the butter is kept. All other considerations fade into insignificance compared with it. It follows then, that the length of time that may elapse between the manufacture of the butter and the date of its consumption, should be the principal guide in determining the temperature that must be employed to secure the best results.

Canadian creamery butter, which is exported to Great Britain, reaches the consumer in not less than four to six weeks after it is made. In many cases it is much longer. Even if we had no rivals on that market, it would be good business policy for us to deliver our butter in the best possible condition and thus encourage consumption. But we have rivalry and competition of the very keenest kind, and it behoves us to study carefully the advantages which our competitors enjoy, and the means that we must employ to place our butter at least on even terms with theirs. The transportation companies and the dealers in whose cold storage warehouses the goods are held, are responsible for a considerable portion of the time, but we do not propose to deal with that phase of the question just now, more particularly as the creamery end is admittedly the weakest part of the whole chain, as far as temperature is concerned.

As for our rivals, Denmark and Ireland far exceed all others in point of quantity. Excepting Normandy, which is really in a class by itself, Denmark ranks superior also in the matter of quality. Nearness to market, and facilities of transport, enable the Irish and Danish buttermakers to deliver their product to consumers in England without its suffering serious deterioration under any circumstances; but even with them, the importance of low temperature is not overlooked. Swedish and Dutch butter belongs to the same category as Danish and Irish, although the quantity is smaller. Siberian butter suffers in storage and transportation, but it is admittedly inferior and therefore offers a standard which is not, or should not be, high enough for Canadian. Although not coming into direct competition, on account of the opposite seasons in the southern hemisphere, we have to consider the Australian, New Zealand and Argentine butters. Notwithstanding the great distances which the butter from these countries must travel, it is a fact, that much of it, especially that from New Zealand, arrives in England showing less deterioration than the butter from any other country, simply because extra precautions are taken to preserve it. Nearly all the creameries in New Zealand have mechanical refrigeration, which permits of temperatures of 10 to 20 degrees being maintained in the creamery cold storages. The butter is shipped every few days to warehouses, where the temperature is maintained at 10 degrees, until it is loaded on the steamer for shipment to London. Thus we find that some of our rivals are so near to the market as to obviate the necessity of elaborate cold storage arrangements, while others sending their butter from a great distance, have adopted such extreme measures for its protection that they are able to place it on the market in fully as good condition as much of that which comes from sources of supply only a short distance away. Our position is a sort of middle ground. We are much too far from the consumer, both in the mattor of time and distance, to ignore the advantage of cold storage, and yet we do not require to go quite so far as our Australasian competitors do.

Buttermakers and creamery managers sometimes argue, that as they can dispose of the butter to the exporters before the deterioration amounts to a difference in price, it does not pay them to provide efficient cold storage at the creameries. Even if this were true, which it is not, it would be a very shortsighted policy, and the person who holds such views, and acts accordingly, is not doing his best in the interests of the farmers who produce the milk. He overlooks the fact that it is the condition of the butter when it reaches the table of the consumer that determines the ultimate price. Every creamery should have a cold storage in which the temperature may be maintained under 38 degrees Fahrenheit. Our records show that very few reach this standard of efficiency. Even at a temperature of 38 degrees or under, the butter should be shipped as quickly as possible to where it will be cared for at a much lower temperature.

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

It was with a view of providing some reliable information of this kind, that a series of experiments was recently planned by the Dairy Commissioner's Branch 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, of varied construction, and the ice chambers in connection with the cool cheese curing rooms, that were designed by the author, and which have been operated by the Department of Agriculture for the last four seasons. Before going any farther, it will be as well to describe briefly some of the different systems of creamery cold storage, that are applicable to Canadian conditions.

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. The two systems of ice storages most generally used at Canadian creameries are known as the 'Air Circulation System' and the 'Cylinder System.'

THE AIR CIRCULATION SYSTEM.

Although it may be *possible* to secure rather lower temperatures with the cylinder system than can be obtained with the air circulation system, we believe that, all things considered, a lower average temperature is usually found where the air circulation system is in use. Both the ice chamber and the cold storage room are thoroughly insulated. Plate I shows plan and section of a creamery refrigerator on the cir-

*Note.—Full details of the experiments will be given in the Dairy Commissioner's Report for 1905.

culation 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 cold storage chamber. The working of such a refrigerator 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.

THE CYLINDER SYSTEM.

In this system galvanized iron cylinders about one foot in diameter are placed in the cold storage room so as to extend from the floor to the ceiling and opening into the room or loft above. A row of these cylinders should extend along at least one-fourth of the wall space of the storage room. The cylinders are filled from above with crushed ice and salt, the proportion of which may be varied according to the temperature desired. The larger the proportion of salt the better the results will be, until the maximum is reached at about 1 part of salt to 3 of ice. Drainage must be provided to carry off the water from the melting ice, and the outlet should always be trapped in order to prevent the passage of air. The ice for this system is usually stored in an ordinary ice shed, covered with sawdust, cut hay or other insulating material. The cylinders must be kept full in order to secure the maximum of refrigeraton. The labour of breaking the ice and filling the cylinders is very considerable and constitutes one of the chief objections to the cylinder system. Where the refrigeration depends upon the daily performance, by the butter maker, of this item of labour, it is very apt to be more or less neglected. If the cylinders are allowed to become partially empty, there is a corresponding rise of temperature in the storage room, and this is what very often occurs. The cylinder system is the cheapest to install, because the storage room only need be insulated, but the large amount of labour involved in keeping the cylinders properly filled, and the cost of the salt, make the operation of this system somewhat expensive. Where there is plenty of cheap labour and someone to take sufficient interest in the question to see that the work is properly attended to there is no doubt but this system will give good results as far as ice goes for the storage of butter. Plate II. shows plan, section and details of a creamery refrigerator on the cylinder system.

INSULATION.

EMPTY SPACES.

Refrigerating engineers have during the last few years practicaly 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.

FILLED SPACES.

In the construction of insulated 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 7 to 9 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

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 waterproofing 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 1-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 boarding is covered with damp-proof paper.

The 1-inch air-space shown in the detail of the ice chamber, includod in the plan for a creamery cold storage on the circulation system (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.

INTERIOR FINISH OF ROOMS.

All inside sheathing should be of spruce, because of its non-odourless character.

The inside surface of ante-rooms and cold storage rooms should receive a coat of shellac, or hard oil. This will permit of the walls being thoroughly washed and disinfected to destroy spores of mould. Whitewash is also used as an interior finish. It is cheap and can be renewed from time to time. A little salt mixed with whitewash is said to harden it and thus prevent it from rubbing off when touched.

If the inside sheathing of the ice chamber is coated with paraffin wax, like a butter box, the lumber will be preserved and moisture prevented from getting into the insulation.

SIZE OF ICE CHAMBER.

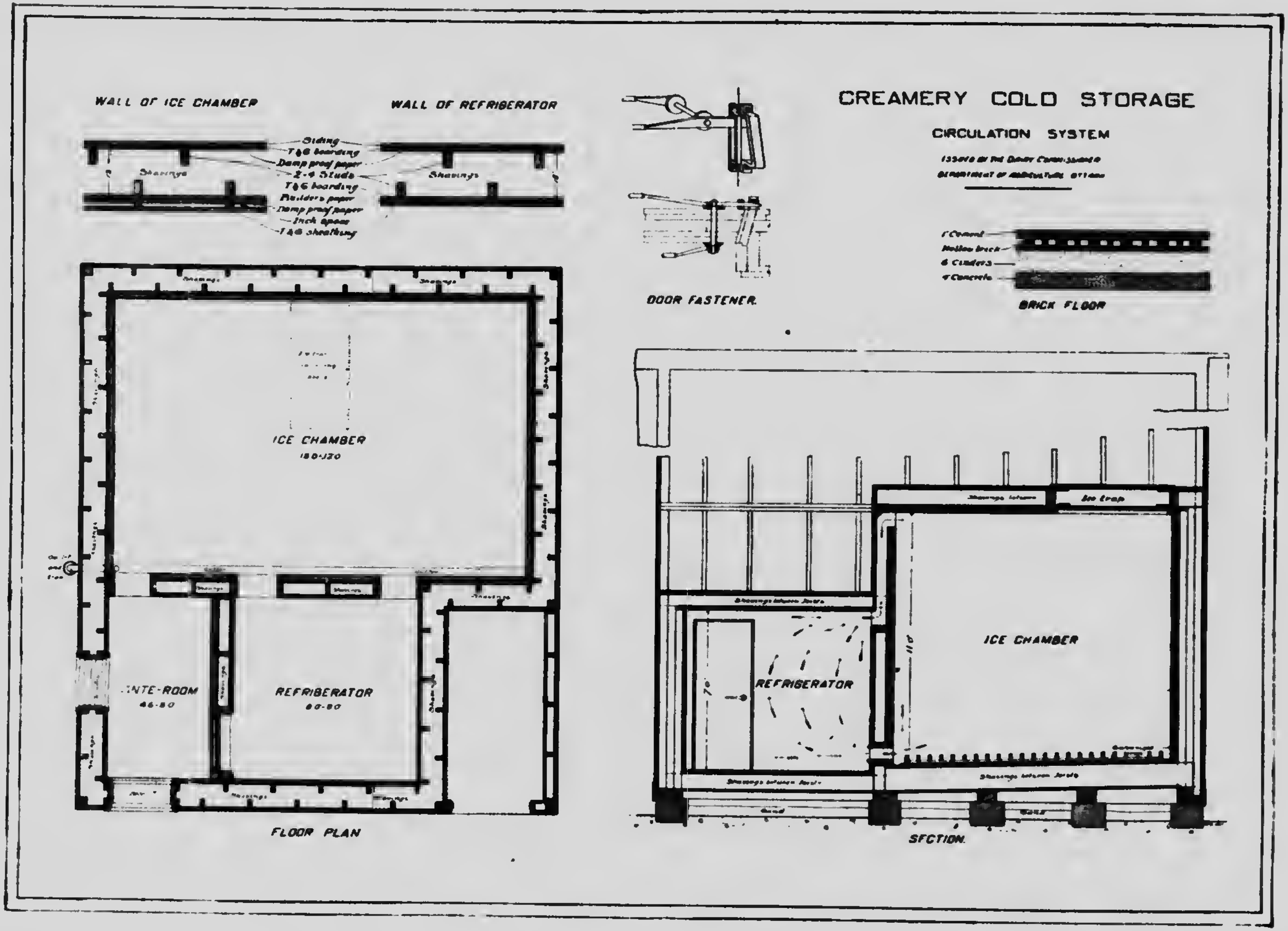
It is impossible to day down any rule as to the total quantity of ice required for creameries with a given output, as so much depends on what the ice is used for, and also on the nature of the water supply. In many creameries, where there is an ample supply of cold water, no ice is used for cream cooling, 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 this system is used the supply of ice for cream cooling purposes should be kept separate from the cold storage supply. The ice chamber should not be opened during the summer except for occasional examination. 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	140	5,000
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.

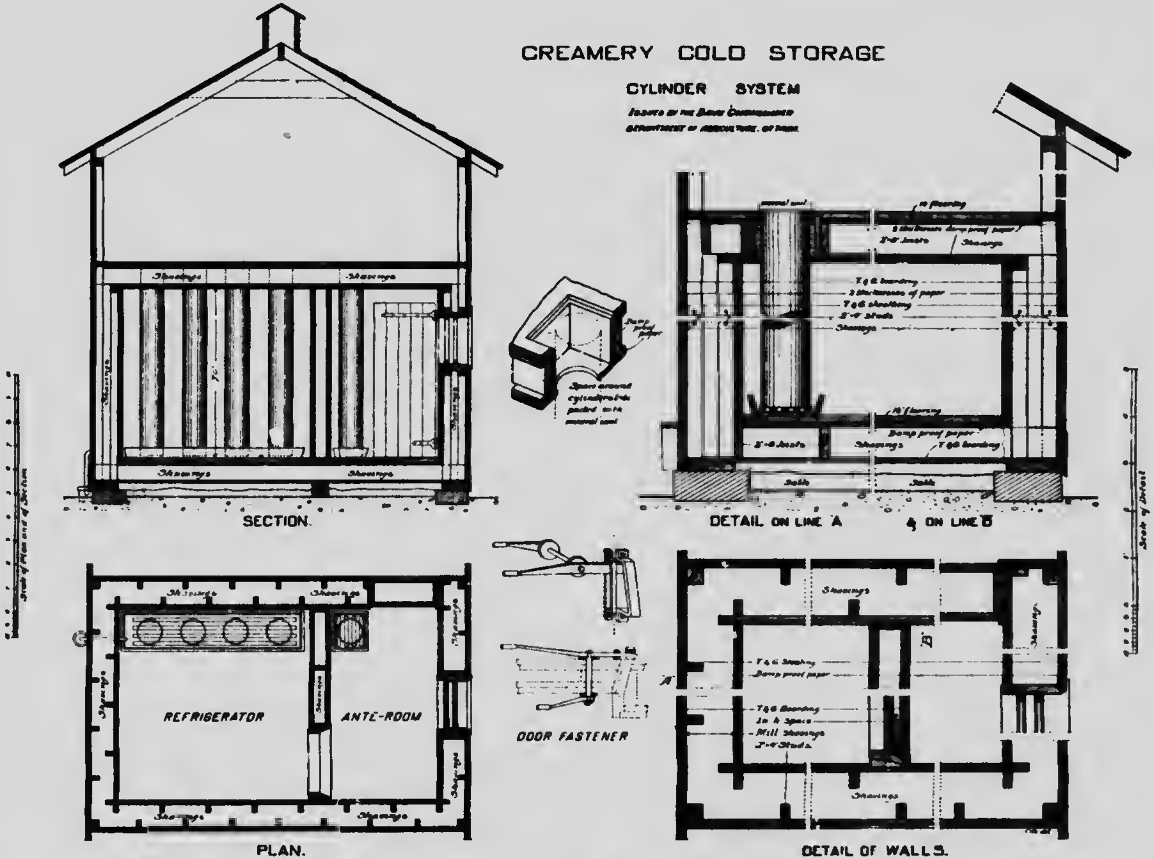
RECOMMENDATIONS.

In the light of our experience, both experimental and practical, we recommend the air 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 specially trained men to be properly put in position. 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. The following specification will be useful to anyone building a cold storage on the circulation system.


CREAMERY COLD STORAGE
CIRCULATION SYSTEM
WALL OF ICE CHAMBER
WALL OF REFRIBERATOR
Siding
T&G boarding
Damp proof paper
2-4 Studs
T&G boarding
Builders paper
Damp proof paper
Inch space
T&G sheathing
Shavings
DOOR FASTENER.
Cement
Hollow brick
Cinders
Concrete
BRICK FLOOR
ICE CHAMBER
180-120
ANTE-ROOM
46-80
REFRIBERATOR
80-80
FLOOR PLAN
Ice trap
ICE CHAMBER
REFRIGERATOR
SECTION.

CREAMERY COLD STORAGE

CYLINDER SYSTEM



SPECIFICATIONS FOR THE CONSTRUCTION OF A CREAMERY REFRIGERATOR—CIRCULATION SYSTEM.

GENERAL.

A refrigerator on the circulation system consists of :

1. An insulated ice chamber, where the ice is kept without any covering.

2. A cold storage room, where the packages of butter for export only shall be stored.

3. An ante-room, to receive retail butter, and to protect the storage room against the entrance of warm air.

Both cold storage room and ante-room are cooled by the circulation of the air which passes over the ice in the ice chamber.

Situation.—At the north end of the creamery, or sheltered from the direct rays of the sun if possible.

Size.—To be determined by the output of the creamery. Butter should be shipped every week wherever possible, and in this case the cold storage room should not be much larger than necessary to hold a week's make, with convenience for handling the packages.

A room 7 feet high by 8 feet square inside will hold conveniently 120 boxes, piled six high.

The ante-room should be large enough so that the door can be conveniently closed before opening the door of the cold storage room.

Light.—It is not desirable to have a window in the cold storage room. Sufficient light can be had from a lamp or a candle when necessary. A window may be put in the ante-room.

Good insulation on all sides.—All sides of the refrigerator, around cold storage room and ante-room, whether adjoining the ice chamber or any other part of the creamery, must be equally well insulated.

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 it odour.

All boards employed should be dressed as w tongued and grooved.

Unseasoned lumber must be carefuly avoid. 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 papers used to be strictly odourless and damp-proof.

Damp-proof insulating papers can be had in rolls of 500 to 1,000 square feet, 36 inches wide. The following brands 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 2 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 odourles wood, such as hemlock, spruce or white wood, to have the preference.

Shavings in compressed bales, weighing from 60 to 100 lbs., 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 gradually, as the inside sheathing is being put on, the shavings thoroughly packed.

About 8 lbs. of shavings, closely packed, will be required for each cubic foot of space filled. For a room 8 x 8 x 7 feet, with ante-room 8 x 4 x 7 feet, built on this specification, 3,000 lbs. will be needed.

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

CONSTRUCTION.

Foundations.—The building to rest on stone or concrete foundations.

Floor in ice chamber.—The area of the floor should be well drained and then covered with 6 to 8 inches of coal cinders, ashes or dry sand.

Lay a light floor which will come about 2 inches below the bottom of the main joists. The joists should be heavy enough, according to the size of the building, to carry the great weight of the ice. The joists may be covered with two courses of 1-inch matched lumber, with damp-proof paper between, or one course of 2-inch tongued and grooved plank. The whole to be finished with galvanized iron, with soldered seams, to make it absolutely water-tight. The galvanized iron should be turned up on the wall about 8 inches. The floor should have a slope of 1 inch in 3 feet, with a gutter at the lower edge, to provide drainage for the melting ice. The drain from the gutter should be trapped to prevent passage of air. An ice rack as shown in plan is necessary to protect the galvanized iron when filling with ice, and also to facilitate drainage. The space between the joists to be filled with shavings.

Floors in the cold storage and ante-rooms.—To be the same as for ice chamber, except that no slope or drainage is required, and it need not be covered with galvanized iron.

Walls.—Set up two rows of 2 x 4-inch studs so as to leave a space of 12 inches as shown in plan. Studs of inside row to be set alternately with the studs of outside row. (See plan.)

Cover outside of frame with tongued and grooved boards, paper and siding.

Provide for an air space in that part of the outside wall which will be exposed to the direct rays of the sun, as follows :—

Cover studs with two thicknesses of boards and paper, lay furring strips 2 x 2 inches, and nail the siding on the strips, leaving the spaces open at top and bottom for circulation of air. (This provision is not shown on plan.)

The inside of the frame to receive two thicknesses of boards, with paper betwe

Ceiling.—Joists 2 x 8 inches at 16-inch centres. Spaces between joists must be filled with shavings. Cover under side of joists with two thicknesses of boards and paper, and cover top with two-ply of boards and paper.

Air-space for ice chamber.—The inside of the ice chamber should have a 1-inch air-space, as shown in the plan, to prevent moisture from the ice penetrating the insulation. It will serve that purpose best if made as follows:—After the double ply of matched lumber on the inside of studs and ceiling is finished cover the whole with damp-proof paper, 1-inch furring strips and one ply of matched lumber. If this last ply of lumber should rot in course of time, it can be renewed without interfering with the other parts.

Partition.—Partition between cold storage room and ante-room should have a six-inch space filled with shavings, with 2 thicknesses of boards and paper on each side.

Doors.—Opening between cold storage room and ante-room to be fitted with door consisting of two-inch skeleton frame covered on both sides with two thicknesses of boards and paper. Edges to be bevelled, and to receive a covering of felt. This door to be fitted with a wrought iron door fastener, as shown on plan.

Opening of ante-room to have two doors, each consisting of two thicknesses of boards with paper.

Window.—The window in ante-room should have two tight-fitting sashes with two panes of glass to each sash, and a shutter on the outside, hinged at the top. Before putting in window-frame, cover sides of opening in wall with two thicknesses of paper.

Shellac.—The inside of both cold storage room and ante-room to receive a coating of shellac.

As some creamery owners may prefer to install the cylinder system, because of the lower first cost, the specification for a creamery cold storage on that system is also given.

SPECIFICATIONS FOR THE CONSTRUCTION OF A CREAMERY REFRIGERATOR—CYLINDER SYSTEM.

GENERAL.

A refrigerator on the cylinder system consists of:—

1. A cold storage room, where only packages of butter for export are to be stored.
2. An ante-room, to receive retail butter and to protect the storage room against the entrance of warm air.

(Both cold storage room and ante-room are cooled with a mixture of ice and salt contained in galvanized iron cylinders. For maintaining a temperature of 36° in a room built on these specifications, about 6 lbs. of salt to every 100 lbs. of ice will be required. The ice should be broken into small pieces and the salt well mixed with it.)

Situation.—Place the cold storage at the north end of the creamery, or sheltered from the direct rays of the sun if possible.

Size.—The size will depend on the output of the creamery. The butter should be shipped every week if possible, and when this is done the cold storage room need not be larger than necessary to hold a week's make, with convenience for handling the packages.

A room 7 feet high by 8 feet square inside will easily hold 120 boxes, piled six high, space for cylinders being deducted.

The ante-room should be large enough so that the door can be conveniently closed before opening the door of the cold storage room.

Good insulation on all sides.—All sides of the refrigerator, around the cold storage and the ante-room, whether adjoining the ice-house or any other part of the creamery, must be equally well insulated.

MATERIALS.

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

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

All boards employed 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 paper used to be strictly odourless and damp.

Damp-proof insulating papers can be had in rolls of 500 to 1,000 sq. feet, 36 inches wide. The following brands 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 two 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 lbs., may be procured from the following firms:—

Wm. Rutherford & Sons Co., Montreal.
J. & G. Esplin, box manufacturers, Montreal.
The Capital Planing Mills, Ottawa.
The Firsbrook 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.

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

About 8 lbs. of shavings, closely packed will be required for each cubic foot of space filled. For a room 8 x 8 x 7 feet with ante-room 8 x 4 x 7 feet, built on this specification, 3,000 lbs. will be needed.

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

CONSTRUCTION.

Foundations.—The building should rest on stone or concrete foundations. The area within the foundations to be covered with a layer of coal cinders, ashes, or sand, 6 to 8 inches deep.

Floor.—Lay centre piece (6 x 6 inches, or 3 x 8 inches on edge) on a level with sills. Across this piece lay false floor made of tongued and grooved boards, extending to outer edge of sills. Cover with two thicknesses of damp-proof paper. Put on floor joists (2 x 8 inches, at 18-inch centres). Fill up spaces between joists with shavings, well packed. Cover top of joists with two thicknesses of boards and paper.

Walls.—[illegible] up two rows of 2 x 4-inch studs so as to leave space of 12 inches as shown in plan. Studs of inside row to be set alternately with the studs of outside row. (See plan.)

Cover outside of frame with tongued and grooved boards, paper and siding.

Provide for an air-space in that part of the outside wall which will be exposed to the direct rays of the sun, as follows:—Cover studs with two thicknesses of boards and paper, lay furring strips 2 x 2 inches, and nail siding on the strips, leaving spaces open at top and bottom for circulation of air. (This provision not shown on plan.)

The inside of the frame to receive two thicknesses of boards, with paper between.

Ceiling.—Joists 2 x 8 inches at 16-inch centres. Spaces between joists must be filled with shavings. Sheet underside of joists with two thicknesses of boards and paper, and cover top with one ply of boards, two papers and 1½-inch planking. (Smashing floor.)

Partition.—Partition between cold storage room and ante-room to have a 6-inch space filled with shavings, with two thicknesses of boards and paper on each side.

Doors.—Opening between cold storage room and ante-room to be fitted with a door consisting of a 2-inch skeleton frame, covered on both sides with two thicknesses of boards and paper. Edges to be bevelled and covered with felt. This door to be fitted with a wrought iron door fastener, as shown in plan.

Ante-room to have two doors, each consisting of two thicknesses of boards with paper.

Cylinders.—Cylinders to be 12 inches in diameter and made of No. 22 gauge galvanized iron.

The cylinders should be placed on one side of the room, 4 inches from the wall, and extending from the bottom of the trough to the top of the smashing floor, through the ceiling. Pack carefully around the cylinders, where they go through the ceiling.

The cylinders should be open at the bottom, and rest in a trough or box 13 inches wide, and 6 inches deep, made of 1½-inch stuff, and lined inside with galvanized iron. The inside of the trough should be fitted with 1 x 2-inch strips to allow for drainage of water.

The trough should have a slope of 2 inches towards one end, and be fitted with 1 inch drainage pipe, which passes through the wall, and discharges outside through a trap to prevent passage of air. The opening around the pipe, where it goes through the wall should be carefully packed with oakum, or similar material.

Cut small openings (6 x 4 inches) in cylinders, near bottom, and fit them with sliding doors, to allow removal of dirt (sawdust, &c.) which may accumulate.

Close cylinders on top with bags filled with dry sawdust, or with tight-fitting wooden plugs.

Five cylinders will be required for a room measuring 8 x 8 x 7 feet. One or two will be needed in the ante-room.

Window.—The window in ante-room should be small and have two tight-fitting sashes with two panes of glass to each sash, and a shutter on the outside hinged at the top. Before putting in window frame, cover sides of opening in wall with two thicknesses of paper. There should be no windows in the cold storage room.

Shellac.—The inside of both cold storage room and ante-room to receive a coating of shellac or hard oil.

INSTRUCTIONS FOR THE ORDINARY STORAGE OF ICE.

1. Provide for drainage by filling the area of the ice-house with broken stones or cobble stones, covered with cinders or gravel. A few inches will do on the top of a gravelly and porous soil. On a heavy clay soil a greater depth will be necessary. A tile drain should be laid in the earth, under the gravel, along the centre of the building.

2. Lay 2 x 6-inch sills, double, and binding at corners, or one sill 8 x 8 feet, on posts. Set up 2 x 6-inch studs at 24-inch centres, topped with 2 x 6-inch plates, double.

Sheet the outside of the studs with matched siding. Line the inside with rough boards, as well as the under side of the rafters. Leave space between studs empty.

Have doors in sections running up from the sill to the gable at one end of the ice-house.

3. Before putting in the ice cover the stones or gravel in the ice-house with 12 inches of *dry* sawdust.

4. Pack the ice directly on the sawdust. Leave a space of 12 inches between the walls and the ice. Place the cakes of ice as close together as possible, and fill in all unavoidable spaces with crushed ice or snow, well rammed. Never use any sawdust between the tiers.

5. Fill the 12-inch space between the ice and the wall with *dry* sawdust. Be careful that the sawdust does not contain any ice chips or snow. When no sawdust is available, cut hay or cut straw, or chaff, may be used, but in this case the space between the wall and the ice should be twice as large (24 inches instead of 12) and care should be taken to have the hay or straw packed as well as possible.

6. Cover the ice on top with sawdust or long hay; 12 inches of sawdust will do. Hay should be put on 2 feet thick. Hay and sawdust make an equally good covering, if used in proper quantities.

When sawdust is used, put on two feet thick at first. This will leave 12 inches to spare to fill in the sides in the spring, when the sawdust along the sides has settled.

7. A loft floor over the ice-house does more harm than good, as it prevents circulation of air and keeps the covering damp. Have an opening at each end of the gable fitted with louvre boards, and have a ventilator 18-inch square going through the middle of the roof to create a thorough circulation of air and thus prevent accumulation of heat under the roof.

8. Bank the ice-house up above the sill with earth or sawdust, in order to prevent any entrance of air around the sill.

NOTES.

1. It may be well to point out that in the construction shown in these plans, the real insulation is the air confined between the inside and the outside sheathing, and made *dead air* by being held in the small spaces among the shavings. It is important, therefore, that these inner and outer shells should be made as nearly impervious as possible. The greatest care should be exercised in making tight joints and leaving no cracks or openings of any kind. Even a nail hole allows a stream of air to pass which, being continuous, soon has an appreciable effect.

2. It is a good plan to hang a canvas curtain over all refrigerator door openings, on the side opposite to that on which the door opens It should be weighted at the bottom, so that it will fall quickly into position after a person passes through. This will prevent loss of cold air, which flows out of a cold room when a door is opened.

3. Many creamery proprietors are deceived as to the actual temperature maintained in their cold storage rooms. A good test is to push the bulb of an ordinary float thermometer about 3 inches into a package of butter which has been in the room two or three days. This will give a fair average of the temperature maintained in the room.

4. The use of salt, with ice, in a refrigerator, does not increase the cooling power of a given weight of ice. The effect of the salt is to cause the ice to melt more rapidly and thus absorb heat more quickly. A ton of ice, in melting, absorbs 284,000 heat units, either with or without salt. With salt the absorption is quickened, hence a lower temperature for a shorter period. A heat unit (B.T.U.) is the amount of heat required to raise 1 pound of water 1 degree F. One pound of ice in melting absorbs 142 heat units.

Copies of this bulletin, in English or French, may be procured, free of charge, by applying to the Dairy Commissioner, Ottawa, Ont.