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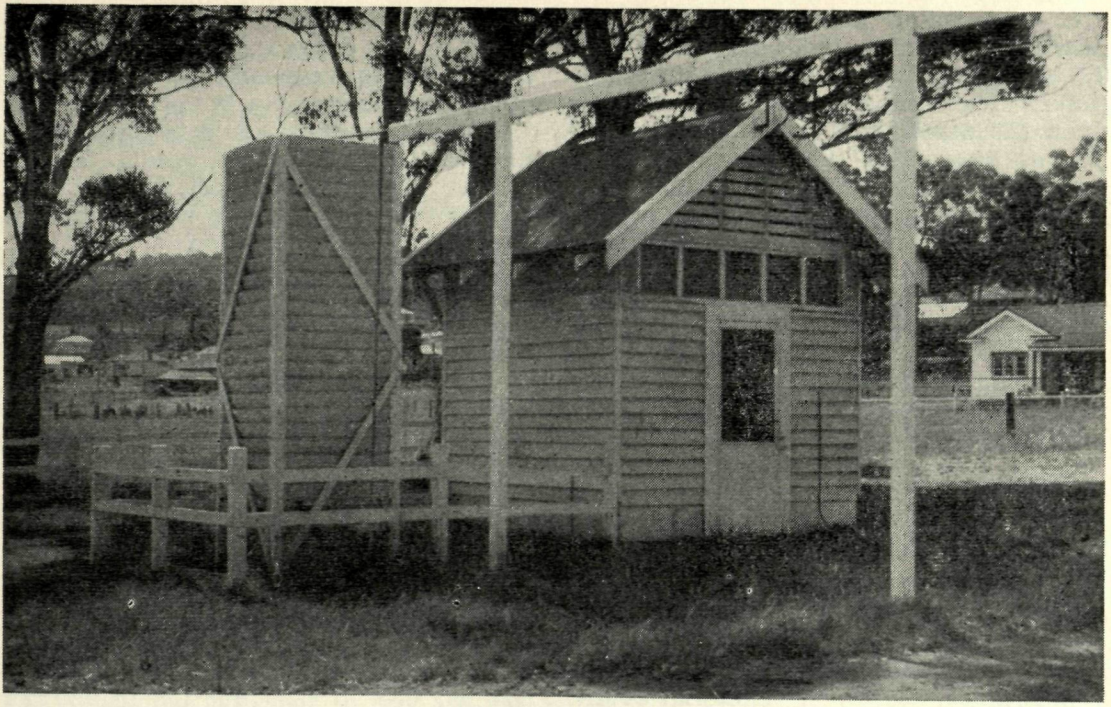

The Queensland-type water tower at the Denmark Research Station

COOLING MILK ON THE FARM

A summary of results of an experiment conducted at the Denmark Research Station

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IN Bulletin No. 968, issued by the Department of Agriculture in 1949, and in the book "Dairying in Australia (W.A. Edition)" there is described a water-cooler tower for use in cooling milk on the dairy farm. This type of tower has gained much prominence in Queensland and is now in general use on dairy farms in that State.

The Dairy Division of the Department of Agriculture in Western Australia has for many years advocated the cooling of milk and cream on farms in this State as a means of raising the quality of milk or cream, but the response by farmers has not been satisfactory. In the wholemilk areas in the State it has been said that, because of twice a day pick-up of milk, there is not much need for cooling on the farm other than by running the milk over an ordinary pipe cooler through which tank water is circulated. It is doubtful whether the temperature reduction brought about by this method would assist much in retarding bacterial increases.

Its efficiency would, of course, depend on the temperature of the water used. Generally on the farm the water used on the cooler circulation is piped from an overhead storage tank and the water in the late spring and summer months may have a temperature of up to 80° or 90° F. which would be useless for the reduction of milk temperature.

On those farms where the mill which supplies the water is close to the dairy, water can be delivered direct to the cooler from the mill but here again a problem is encountered—the breeze to drive the mill at milking time may not be available, and therefore the windmill may be inactive at the time when it is most wanted.

Ground water temperature can vary considerably and ranges between 55° and 78° F. or even higher under certain conditions. The temperature largely depends upon the depth from which the water is drawn. In summer the average temperature of a shallow well could be between 70° and 78°—much too high for effective cooling of the milk.

In areas of the State where milk is supplied to cheese factories the position is worse because practically no cooling of milk is carried out on the farm, hence the amount of second-grade milk delivered to cheese factories is relatively high.

While it is not the wish of the writer to weary the reader with a lot of figures, it is desired that the farmer realise how bacteria can increase under favourable temperature conditions.

The table below shows the increase of bacteria in milk held for 24 hours at various temperatures:—

Temperature. °F.	Bacterial Count. Per cc.
32	2,400
39	2,500
43	3,100
50	11,600
55	18,800
60	180,000
68	450,000
86	1,400,000,000
95	25,000,000,000

It will be noted that in the range 32° to 55° F. comparatively little growth was noted. Between 55° and 68° F. the growth was fairly rapid and above 68° F. the increased growth was fantastic. These figures, which are authentic, show very clearly that if we are to raise the quality of the product produced, two things are absolutely necessary:—

(1) High standard of hygiene.

(2) Cooling of milk or cream as produced.

Cooling, to be really successful, must reduce the milk temperature as close as possible to 50° F. How then can farm tank water be reduced to a lower temperature than normal to bring this about?

It was with regard to the latter that the Department of Agriculture, Dairy Division, decided to experiment with the Queensland type water tower in order to demonstrate to the dairy farmer in this State that, with the expenditure of a small amount of cash and a little labour, milk cooling on the farm could be carried out quite easily and give good results. To this end with a minimum of cost, a Queensland type water cooling tower was erected at Denmark Research Station.

CONSTRUCTION AND DESCRIPTION

The construction was as described in the Department of Agriculture Bulletin 968 (a few copies of which are still available), and in "Dairying in Australia (W.A. edition)." The system of cooling is by water recirculation from a shallow concrete pit at the foot of the atmospheric cooling tower. The water is drawn from this pit (which is only 12 in. deep) by a $\frac{3}{4}$ in. centrifugal pump driven from the dairy engine room shafting. The water is pumped through an ordinary milk cooler mounted in brackets at a suitable height beneath the milk vat stand. The water, after cooling the milk, is delivered back to the top of the cooling tower. The tower is placed so that it is in the path of the prevailing winds, especially those which blow in the summer months for it is at this period that the largest amount of cooling is required.

The tower need not be far distant from the dairy so long as there is plenty of air circulation on all sides of the tower.

Large amounts of water are not really necessary. The pit shown in the plans only holds approximately 180 gallons. A deep pit is not recommended as there is a tendency for a large bulk of water to heat up considerably in the summer and the heat has to be dissipated on the tower before efficient cooling can be achieved.

Hence a small bulk cools quicker and is available for the necessary work in a shorter time. The shallow pit has other advantages:—

(1) Low cost.

(2) Ease of cleaning when necessary.

(3) Easier lift for the pump, therefore greater circulation of the water.

SITUATION OF TOWER

In the experiment at Denmark Research Station, the cooler tower was built approximately 55 ft. from the dairy. Conditions were such that it was not possible to build it closer and have good air circulation all round the tower. This was a distinct disadvantage because it meant greater length of pipes and therefore more friction inside the pipe and a slight reduction in water circulation capacity.

SITUATION OF PUMP

The water pump was installed in the separator room and driven off the separator counter shaft at 1,250 r.p.m. Approximately 60 ft. of 1 in. piping was laid down from the pit to the pump with a foot valve on the suction end.

CAPACITY OF PUMP

Water delivery at the pump was approximately 500 gallons per hour, which was considered sufficient to cool 166 gallons of milk per hour at the rate of 3 gallons of water to 1 gallon milk.

The cooler used was an ordinary tinned copper pear-shaped tube milk cooler 2-can size—9 pipes high approximate size 30 in. wide x 18 in., deep with $\frac{3}{4}$ in. water connections. Delivery of water through cooler was approximately 400 gallons per hour with the pump speed of 1,250 r.p.m.

COOLER WATER RETURN

Water passing through the cooler was piped back to the top of the tower at 13 ft. height through $\frac{3}{4}$ in. galvanised piping at a flow of approximately 277 gallons per hour at top of tower.

The cooler water then falls down over the slats in the tower in droplets and reaches the pit from where it is recirculated again through the cooling plant.

The cost of materials used in the construction of the tower and pit, plus the piping used to reticulate the water and the $\frac{3}{4}$ in. centrifugal pump was approximately £37 10s.; the work of erection of stand and the cementing of the circulation pit and laying of pipe lines being done by the Research Station staff.

COOLING TOWER EXPERIMENT—DENMARK RESEARCH STATION

Monthly Temperature Avgs. Degrees Fah.

	MORNING							EVENING						
	Temp. Milk in Vat°	Temp. Cooled Milk°	Temp. Drop Fah.°	Temp. Pit Water Fah.°	Diff. Cooled Milk-Water	Atmos. Temp.	Diff. Atmos. and Pit Water	Temp. Milk in Vat°	Temp. Cooled Milk°	Temp. Drop	Temp. Pit Water Fah.°	Diff. Cooled Milk-Water	Atmos. Temp.	Diff. Atmos. and Pit Water
1956—														
July	79·00	59·71	19·29	47·03	12·68	49·00	—1·97	79·94	62·74	17·20	50·61	12·13	53·39	—2·78
August	81·20	50·53	25·67	45·13	10·40	47·93	—2·80	80·13	57·20	22·93	49·80	7·40	54·53	—4·73
September	78·76	55·52	23·24	47·38	8·14	50·07	—3·29	79·41	59·34	20·07	53·14	6·20	58·45	—5·31
October	81·77	59·37	22·40	49·77	9·60	52·23	—2·46	82·43	62·33	20·10	55·57	6·76	57·87	—2·30
November... ...	85·17	62·27	22·90	54·00	8·27	56·07	—2·07	86·48	66·59	19·89	60·62	5·87	64·21	—3·59
December	87·84	66·10	21·74	58·03	8·07	60·45	—2·42	89·32	69·23	20·09	62·16	7·07	67·52	—5·36
1957—														
January	88·94	67·16	21·78	59·23	7·83	62·97	—3·74	90·23	71·39	18·84	63·90	7·49	72·84	—8·94
February	86·10	65·50	20·60	58·50	7·00	61·30	—2·80	88·90	71·20	17·70	68·00	3·20	73·40	—5·40
March	84·00	61·10	22·90	56·51	4·59	59·42	—2·91	87·67	66·45	21·22	61·77	4·68	69·10	—7·33
April	80·40	57·40	23·00	52·68	4·72	55·10	—2·42	84·80	63·70	21·10	60·10	3·60	64·70	—4·60
May	80·30	56·77	23·53	51·70	5·07	54·00	—2·30	84·74	62·60	22·14	57·40	5·20	61·40	—4·00
June	82·90	58·60	24·30	51·40	7·20	53·60	—2·20	85·60	61·70	23·90	55·80	5·90	57·40	—5·90

The experiment was carried out over a period of 12 months.

Temperature recordings were made at both milkings as follows:—

(1) Temperature of milk at vat.

(2) Temperature of cooled milk.

(3) Temperature of pit water.

(4) Atmospheric temperature.

From these figures the general temperature reductions were worked out and averages drawn for the month and the difference between the cooling medium and the cooled milk were worked out.

WATER CIRCULATION

Circulation of the cooling water from the pit through the cooler commenced with the starting up of the engine used for milking and this circulation was responsible for the reduction of the water to an average of 2.6 degrees F. below the ruling atmospheric temperature for the period in the mornings and 5° F. in the evenings prior to the commencement of the actual cooling process.

MILK TEMPERATURES

It will be seen from the table printed herewith that the milk temperatures at the milk vat are relatively low, but it must be explained that bucket milking rather than pipeline milking was practised for the larger portion of the period of the experiment.

Had normal milk temperatures been the rule, reduction of temperature between vat milk and cooled milk would have been greater than those listed.

It will be noted that the drop in temperature of the milk over the cooler ranged from 19.29° F. in July, 1956, to 24.3° F. in June, 1957, with an average for the 12 months of 22.61° F. and the evening period reduction 17.2° F. to 23.9° F. with an average reduction for the 12 months of 20.43 ° F. These figures indicate quite clearly that, for a normal outlay, reasonably good cooling of milk can be carried out on the farm with the aid of the cooling tower and with only a relatively small quantity of water, and should be quite within the reach of the average farmer.