New Potato Dryer

wash water completely removed in 2–5 minutes without damage to potatoes

J. R. Tavernetti and S. M. Henderson

Losses from bacterial soft rot are most prevalent in winter, when atmospheric conditions are such that potatoes remain wet or damp after washing and packaging. Experiments have shown that the disease develops rapidly when relative humidity is 90% or higher and temperature is 60°F or warmer, and that it can be prevented by drying potatoes after washing.

The amount of drying required to prevent the rot is affected by atmospheric conditions, type of packaging, ventilation after packaging, time and temperature of storage, and perhaps other factors. To prevent rot development under practically all conditions, it is assumed that all surface moisture must be removed from the potatoes.

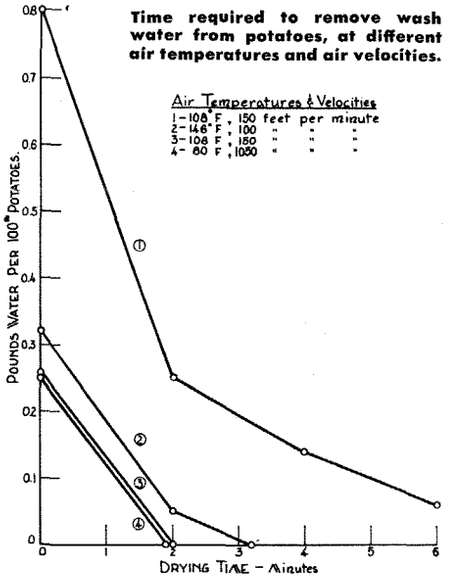
A water eliminator—a series of brush or sponge rolls—removes the loose water clinging to potatoes after washing but leaves a film of surface moisture and some water in the eyes. In laboratory experiments, potatoes dipped in water and allowed to drain a few seconds retained 1.2 pounds of water per 100 pounds of potatoes. After rolling on an absorbent blanket they still retained 0.6 pound of water per 100 pounds. In an experiment in a Kern County packing house, potatoes conveyed about 40′ on rubber belts after going through the washers retained 0.8 pound of water per 100 pounds; after going over the sponge rolls, they still carried 0.5 pound of water per 100 pounds.

For complete removal of wash water before packaging, artificial drying is necessary. Several commercial units, using either heated air or a combination of heated air and direct radiation from infrared lamps, are on the market, but they are relatively expensive and are difficult to install because of their size, particularly their length.

Experimental Dryer

Results of laboratory tests made with potatoes in a single layer are shown in the graph. Curve *1* is for potatoes dipped in water and drained a short time before drying. Curves *2*, *3*, and *4* are for potatoes dipped in water and rolled in an absorbent cloth before drying. The results show that both air temperature and air velocity are factors in the drying time, and that 2–5 minutes would be sufficient for most conditions. Calculations indicated that approximately 1,200 B.T.U.—British thermal units—of heat and 1,000 cubic feet of air would be required to dry 100 pounds of potatoes.

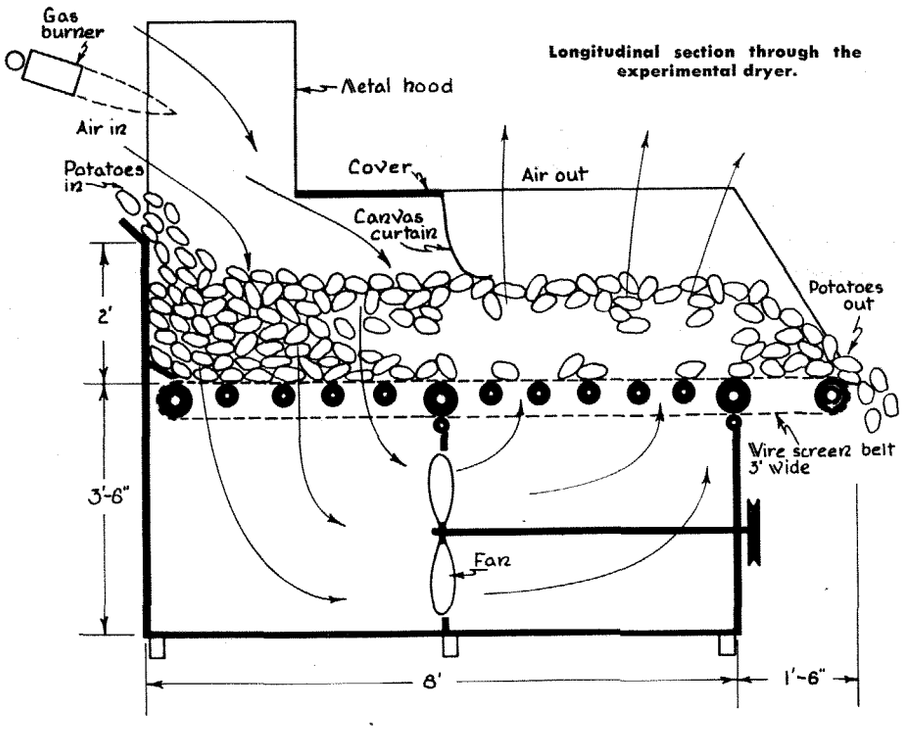
With these data as a basis, an experimental dryer was designed and built. The design differs in several features from dryers now available. Potatoes are moved through the dryer in a mass rather than in a single layer, so it is possible to move a large volume with a slow conveyor speed. Thus the unit can be relatively short and still hold the potatoes in it a sufficient time for drying. The drying air passes through the mass of potatoes twice, giving a relatively high thermal efficiency. The warmest and driest air comes in contact with the wettest potatoes, tending to decrease damage from overheating or overdrying.



Time required to remove wash water from potatoes, at different air temperatures and air velocities.

The schematic drawing shows a longitudinal section through the dryer. A rectangular box, partially open on the ends and top, is divided into upper and lower compartments by a wire screen belt supported on rollers. Potatoes are fed into the upper part at one end and conveyed by the belt to the other end, where they are discharged. The lower part is entirely enclosed except for the screen belt on top, and is divided in two by a partition which surrounds a fan. Air is drawn by the fan down through the potatoes and belt at the inlet end and blown up through the belt and potatoes at the discharge end. A hood, cover, and curtain on the top of the dryer cause incoming air to be drawn around open flame gas burners above the potato inlet.

The box is made of one-half inch exterior plywood on an angle-iron frame. The upper or potato portion is lined with sheet metal. The fan is a 7-blade propeller type driven at 1,750 revolutions per minute by a three horsepower motor. At this speed it has a rating of 8,000 cubic feet of air per minute against a static pressure of 1″ of water, and 5,000



Longitudinal section through the experimental dryer.

cubic feet against 1.5″ pressure. In actual operation the static pressure was 1.2″ when the potatoes were 10″–12″ deep on the belt. The wire screen belt is driven through a speed reducer by a one-half horsepower motor. The speed of the belt can be changed by varying the pulley ratio between the motor and the speed reducer.

The dryer was tested to a limited extent in two different packing houses in Kern County. The first was at Shafter, in the spring of 1958. Potatoes were discharged directly into the dryer from a water eliminator with sponge rubber rolls. Both units were located between the end of the sorting belt and the sacker for the No. 1 potatoes. Because of the small volume of potatoes being handled, the conveyor belt was run at a speed which retained the potatoes in the dryer for five minutes. No auxiliary heat was used, because sufficient time was allowed to accomplish drying with natural air. Potatoes came out dry in four out of five tests, as shown in the upper table.

The second test was at Tehachapi in late summer, 1958. Auxiliary heat was not used because no convenient gas supply was available. To handle the volume of potatoes being packaged, potatoes were retained in the dryer only two minutes.

The first runs—without a water eliminator—left the potatoes wet. Before September 8, a sponge roll water eliminator was placed between the last washer and the sorting belt. Thereafter, the degree of dryness attained varied according to the temperature and relative humidity of the air. Results are given in the lower table. With an air temperature of 82°F and 30% relative humidity, practically complete drying was accomplished. With an air temperature of 74°F and 54% humidity, only partial drying was accomplished.

The general construction of the dryer has been satisfactory in the preliminary tests. Auxiliary heat will be necessary when air temperature is below 80°F and relative humidity above 30%. For maximum capacity, higher air temperature may be required. Observations indicated that 18″ is about the practical limit for the depth of potatoes, that two minutes is the minimum for drying and a longer time is necessary under some conditions, and that the maximum capacity of the experimental unit is about 300 sacks per hour. Greater capacity could be obtained by making the drying unit wider and longer.

It is possible that drying time could be reduced and capacity increased by using heated air at temperatures as high as 150°F. To reduce the amount of water to be removed, a water eliminator ahead of the dryer is very desirable.

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James B. Kendrick, Jr., Associate Plant Pathologist, University of California, Riverside, determined the conditions for development of bacterial soft rot. Charles Sill Co., Shafter, and Summit Farms Co., Tehachapi, cooperated in testing the dryer in their packing houses.

Development of the dryer was requested and funds provided by the Research Committee of the California Long White Potato Advisory Board.

The above progress report is based on Research Project No. 947.

Observations on Experimental Potato Dryer at Shafter, 1958

Date and hour	100-lb. sacks /hour	Air into dryer		Air in bottom of dryer		Air out of dryer		Condition of potatoes out of dryer
		Temp. °F	Humid. %	Temp. °F	Humid. %	Temp. °F	Humid. %	
April 16								
11 a.m.	150	78°	39%	76°	51%	74°	58%	Dry
8 p.m.	90	70°	68%	69°	76%	68°	80%	Dry
10 p.m.	105	66°	71%	66°	75%	65°	80%	Slightly damp
April 17								
1 p.m.	135	76°	44%	73°	53%	72°	57%	Dry
6 p.m.	180	74°	58%	72°	65%	70°	72%	Dry

Observations on Experimental Potato Dryer at Tehachapi, 1958

Date and hour	100-lb. sacks /hour **	Air into dryer		Air in bottom of dryer		Air out of dryer		Condition of potatoes out of dryer
		Temp. °F	Humid. %	Temp. °F	Humid. %	Temp. °F	Humid. %	
Sept. 3*								
11 a.m.	225	76°	38%	70°	55%	67°	75%	Wet
4 p.m.	225	80°	34%	72°	65%	70°	72%	Wet
Sept. 8								
3 p.m.	260	82°	30%	75°	62%	74°	65%	Dry
Sept. 10								
11 a.m.	250	74°	54%	70°	77%	70°	77%	Damp
2 p.m.	180	77°	42%	73°	57%	73°	61%	Slightly damp

* A sponge roll water eliminator was installed ahead of the dryer between September 3 and September 8.

** Potatoes were in the dryer 2 minutes.

HARVEST

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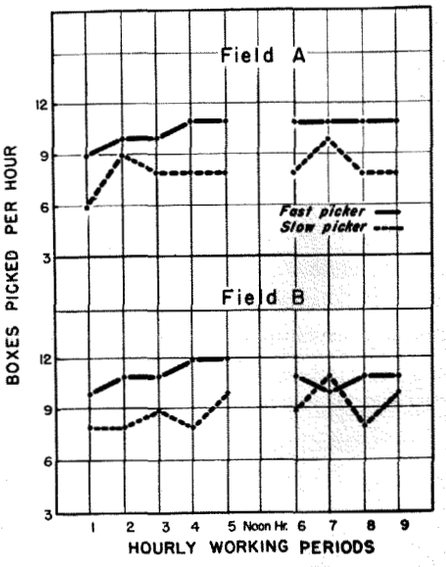
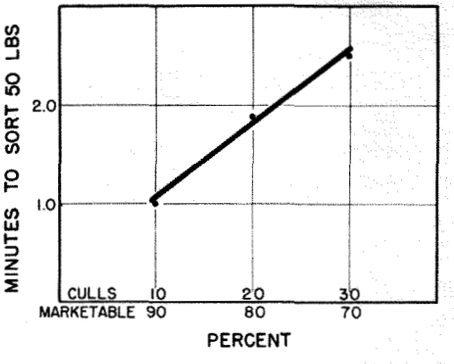
The most fatiguing operation is carrying the full lug boxes. In moving the boxes, an average picker usually carries 2.8 tons a distance of about 60′ in a day. When a man is carrying a box weighing 44–48 pounds, the pace that tires him least is 2.6 miles an hour or 228′ per minute. The best method of carrying the full lug box is on the shoulder.

Hourly picking rates of slow and fast pickers.



Sorting time increases with the amount of culls.



Good cultural methods will usually make the harvesting operation easier. Good yields and freedom from weeds let the pickers work faster and encourage them to greater output.

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Further details on work simplification methods for vegetable growers are given in Leaflet 57, which may be obtained without cost at the office of the County Farm Advisor or by addressing a request to Agricultural Publications, 207 University Hall, University of California, Berkeley 4.