ates Department of Agriculture
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tern Forest Experiment Station
NEINF-39-81

Steps To Savings

How to Build Your Own Maple Sap Preheater

Slide Presentation

1. Title slide.

2. Early maple syrup makers used whatever techniques were available to boil sap, with little concern for efficiency or cost. Indians poured sap into hollow tree trunks, and boiled it with heated stones,

3. while the colonists used iron or copper kettles fired with wood.

4. Next came iron pans,

5. followed by today's evaporator.

6. The evaporator systems available today differ little from each other.

7. Their economic efficiency depends mainly on the availability, thermal characteristics, and cost of the chosen fuel.

8. Yet a more efficient evaporator would give maple syrup producers a much-needed boost in the face of fluctuating demand and rising fuel costs.

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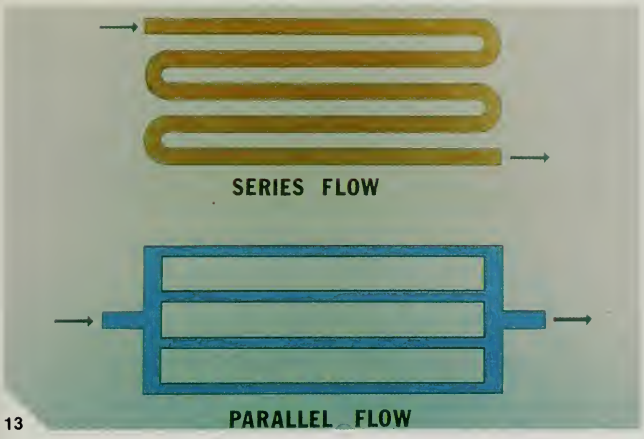
9. The development that currently offers the most promise for increasing evaporator efficiency is the heat exchanger or preheater.

10. In this energy-saving system, steam from the evaporating sap is used to heat incoming sap, which passes through pipes on its way to the sap pan.

11. A preheater can be added to an existing evaporator for a small initial cost.

12. The quality of the syrup will not be affected, and processing will cost less because less energy will be lost. A preheater increases the hourly evaporation rate and syrup production by about 15 percent.



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13. A preheater can be designed with either series or parallel flow. In a series design, such as the one developed by George Raithby at the University of Waterloo in Ontario, sap flows through a continuous pipe arranged in a bundle over the sap pan. In the parallel design developed by Howard Duchacek at the University of Vermont in cooperation with the Forest Service, sap flows simultaneously through a single layer of tubes connected by manifolds at each end.

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14. Experiments have shown that series and parallel flow designs result in the same increase in evaporator efficiency. However, advantages of the parallel design are that it is easier to make, especially by a sugar maker; is flexible enough to fit under the many types of steam hoods already in place; and has a lower sap feed head requirement.

15. A parallel flow preheater is easily constructed.

16. To build your own, start by determining the hourly sap flow through your evaporator. You can measure it directly with a water meter,

17. or apply a rule of thumb. For example, if you burn oil, you can estimate sap flow by multiplying 10 times the number of gallons of oil you burn per hour.

18. Or you can multiply the square footage of your evaporator by two to obtain a conservative estimate of sap flow. To be sure the preheater is large enough, increase this figure by 20 percent.

19. The table found in Forest Service research paper NE-388 gives the dimensions for design elements in the preheater, based on the rate of sap flow. Let's look at one example. If sap flow is 50 gallons per hour, we would use 20 feet of 3/4-inch copper tubing.

20. Manifolds would be 1-1/4 inches in diameter. A single bank of six tubes, each 1-3/4 inches apart, would total 40 inches in length.

21. The inlet and outlet from the manifold would be 1 inch in diameter. The diameter of the steam hood stack would be 6 inches, and the feed tank head at least 1.2 feet. These dimensions are minimum values and slight deviations will occur. The critical factor is the length of the tubing, or more properly, the surface area. Use the recommended total length to get the maximum potential from your preheater.

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22. The preheater consists of three parts: a tube bank,

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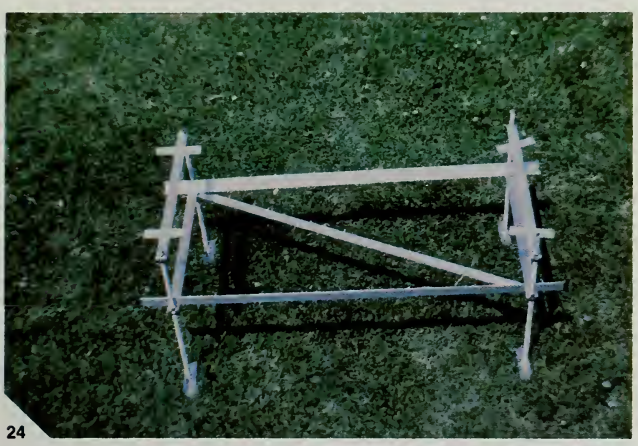
23. a drip pan,



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24. and a support for these parts.

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25. Before you begin actual construction, determine the length, width,

26. and depth of the back pan.

27. Measure the height of the sap tank outlet,

28. and the expected height of the sap inlet on the preheater. The difference in height should equal or exceed the minimum head required by the table.

29. To construct the preheater, you'll need a torch, lighter, 50/50 solder, solder flux, copper tubing cutter, tape measure, hacksaw, screwdriver, wrenches, electric drill and bits, and steel wool. We had the drip pan made in a sheet metal shop, and used a hole cutter, tin snips and a saber saw with a metal cutting blade to modify the existing steam hood.

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30. The easiest-to-construct manifold calls for copper tees and short connecting tubes. In this case we used 1 x 3/4-inch tees with 1 x 3/4-inch elbows on the ends. Two 1 x 1-inch tees form the inlet and outlet near the middle of the manifold.

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31. To begin, cut short sections of pipe to fit between the tee fittings ..

32. .....

33. Clean these sections, and all parts to be soldered, with steel wool to insure a good sweat joint.

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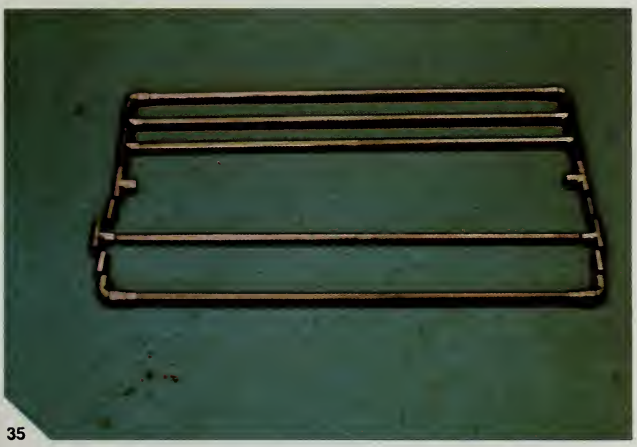
34. Apply flux to the manifold pieces and assemble them.



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35. Cut five 40-inch sections of 3/4-inch tubing and one 40-inch section of 1-inch tubing. The 1-inch tubing will serve two functions: as sap inlet to the manifold, and as a heat exchanger tube.

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36. Assemble the five 3/4-inch tubes into the manifold and solder all joints except the 1 x 1-inch tee, which will be used for the inlet. To insure the proper fit, solder this connection after the unit has been placed on the evaporator.

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37. Next drill a hole in the top of the 1 x 1-inch outlet tee to accommodate a piece of 1/4-inch copper tubing. Insert a petcock in line. The tubing should be long enough to bend beyond the drip pan. This relieves pressure from the system, preventing air or steam lock, and is necessary for proper functioning of the preheater.

38. Here is a completed tube bank, ready to be attached to an evaporator.

39. You can hang the preheater from the hood, suspend it above the pan on aluminum angle supports, or make it free-standing as we did here.

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40. For the free-standing model, we made a support from threaded rod, aluminum angle, and flat stock. The threaded rods serve as legs. To prevent damage to the pan, we made feet from short pieces of angle. To prevent problems with rust, more costly aluminum or stainless steel rods and nuts could be used.

41. The angle and flat stock form a support for the drip pan. Flat stock supports the tube bank, too. With the threaded rod, you can adjust the angle to insure that the drip pan drains and the tube bank stays at the proper slope.

42. Make the drip pan just large enough to catch the condensate from the tube banks and manifold. The pan should have a drain in one corner.

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43. After you assemble the unit with approximate adjustments for the height of the tube bank,

44. and the drip pan,

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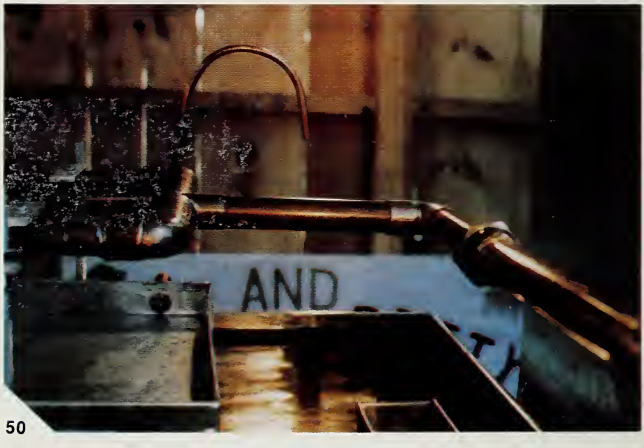
45. it is ready to be installed on the evaporator.

46. Make your final adjustments allowing for the height of the tube bank and drip pan. Adjust the drip pan so it slopes toward the drain.

47. Place the tube bank on a 3 percent slope up from the inlet manifold,

48. to the outlet manifold.

49. Next measure the lengths you will need for inlet and outlet pipes. The outlet will feed into the regulator box.



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50. Solder unions in the lines so that you can detach the hood without moving the preheater.

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51. Position and solder the inlet pipe,

52. which connects to the sap feed tank.

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53. Now you can modify the steam hood to accept the preheater. Mark and cut holes as small as possible to accept the inlet and outlet pipes.

54. Do the same for the drip pan hole.

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55. Finally, insert a damper about 18 inches above the steam hood. Use galvanized sheet metal for the damper and an iron rod for a damper control.

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56. We constructed this unit, not including the steam hood, for a 3 x 8 evaporator at the Forest Service research laboratory in Burlington, Vermont, for less than $90 in materials in 1980. During the first season of operation, if you burn oil that costs $1.00 per gallon, you will save in oil alone more than you pay for materials.

57. Many parallel flow preheaters, both homemade and purchased, are in use today. They provide significant savings in fuel, as well as a steady flow of hot water from the drip pan for use in the sugarhouse.

58. For more information on the maple sap preheater, contact the Forest Service Sugar Maple Laboratory in Burlington, Vermont.

59. This has been a Forest Service presentation.