Practice: 372 - Combustion System Improvement

Scenario: #10 - RO<=200 GPH

Scenario Description:

Reverse osmosis (RO) unit is installed to concentrate the sugar content of sap prior to boiling to decrease boiling time and fuel use. RO units use a combination of electric high pressure pumps and membranes to concentrate the sap. Use for units rated at 200 GPH or less. Complete unit is added to operation with an existing evaporator to process sap before it enters the maple evaporator. Boiling time for concentrated sap is greatly reduced. Typical capacity of the RO unit is 125 GPH. Completion of an Agricultural Energy Managment Plan AgEMP or equivelant energy audit indentifies the energy savings with planned installation of the RO unit. Units are typicllay manfactured for maple applications. Associated Practices: AgEMP CAP 122

Before Situation:

1000 tap maple operation with a fuel oil fired evaporater running all sap through the evaporator and no existing RO. Sap is 1-2% sugar . All concentration is through evaporator with excessive boil time, fuel use, and emissions.

After Situation:

Sap is processed through RO before entering the evaporator. Sap is concentrated to 8% or more drastically reducing boil time, fuel consumption and emissions. Any improvements are based on a Type 2 energy audit meeting the requirements of ASABE S612.

Scenario Feature Measure: Capacity of RO

Scenario Unit: Gallon per Hour

Scenario Typical Size: 125

Scenario Cost: $3,889.74 **Scenario Cost/Unit:** $31.12

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Labor						
Skilled Labor	230	Labor requiring a high level skill set: Includes carpenters, welders, electricians, conservation professionals involved with data collection, monitoring, and or record keeping, etc.	Hour	$33.20	8	$265.60
Materials						
Reverse Osmosis unit, variable cost portion	2225	Variable cost portion of a reverse osmosis unit used for maple syrup processing. Materials only.	Gallons per Hour	$17.20	125	$2,150.00
Reverse Osmosis unit, fixed cost portion	2224	Fixed cost portion of a reverse osmosis unit used for maple syrup processing. Materials only.	Each	$1,474.14	1	$1,474.14

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Scenario: #11 - RO>200-600 GPH

Scenario Description:

Reverse osmosis (RO) unit is intalled to concentrate the sugar content of sap prior to boiling to decrease boiling time and fuel use. RO units use a combination of electric high pressure pumps and membranes to concentrate the sap. Use for units rated at greater than 200 GPH and less than or equal to 600 GPH. Complete unit is added to operation with an existing evaporator only to increase existing RO capacity to process sap before it enters the maple evaporator. Boiling time for concentrated sap is greatly reduced. Typical capacity is 600 GPH. Completion of an Agricultural Energy Managment Plan AgEMP or equivelant energy audit indentifies the energy savings with planned installation of the RO unit. Units are typicllay manfactured for maple
applications.

Associated Practices: AgEMP CAP 122

Before Situation:

3000 tap maple operation with a fuel oil fired evaporater running all sap through the evaporator and no existing RO. Sap is 1-2% sugar. All concentration is from combustion evaporation with excessive boil time, fuel use, and emissions.

After Situation:

Sap is processed through RO before entering the evaporator. Sap is concentrated to 8% or more drastically reducing boil time, fuel consumption, and emissions. Any improvements are based on a Type 2 energy audit meeting the requirements of ASABE S612.

Scenario Feature Measure: Capacity of RO

Scenario Unit: Gallon per Hour

Scenario Typical Size: 600

Scenario Cost: $12,325.34 **Scenario Cost/Unit:** $20.54

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Labor						
Skilled Labor	230	Labor requiring a high level skill set: Includes carpenters, welders, electricians, conservation professionals involved with data collection, monitoring, and or record keeping, etc.	Hour	$33.20	16	$531.20
Materials						
Reverse Osmosis unit, variable cost portion	2225	Variable cost portion of a reverse osmosis unit used for maple syrup processing. Materials only.	Gallons per Hour	$17.20	600	$10,320.00
Reverse Osmosis unit, fixed cost portion	2224	Fixed cost portion of a reverse osmosis unit used for maple syrup processing. Materials only.	Each	$1,474.14	1	$1,474.14

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Scenario: #12 - RO >600 GPH or add on

Scenario Description:

Reverse osmosis (RO) unit is intalled to concentrate the sugar content of sap prior to boiling to decrease boiling time and fuel use. RO units use a combination of electric high pressure pumps and membranes to concentrate the sap. An add-on unit is added to an existing RO unit to increase existing RO capacity to process sap before it enters the maple evaporato or a large complete RO unit greater than 600 GPH is installed. Typical unit is 1200 GPH. Boiling time for concentrated sap is greatly reduced. Completion of an Agricultural Energy Managment Plan AgEMP or equivelant energy audit indentifies the energy savings with planned installation of the RO unit. Units are typicllay manfactured for maple applications. Associated Practices: AgEMP CAP 122

Before Situation:

5000 tap maple operation with a fuel oil fired evaporater running all sap through an existing RO that is under sized causing increased boil time, fuel consumption, and emissions.

After Situation:

Sap is processed through expanded RO before entering the evaporator. Sap is concentrated to 14% or more drastically reducing boil time, fuel consumption, and emissions. Any improvements are based on a Type 2 energy audit meeting the requirements of ASABE S612.

Scenario Feature Measure: Capacity of RO

Scenario Unit: Gallon per Hour

Scenario Typical Size: 1,200

Scenario Cost: $20,905.60 **Scenario Cost/Unit:** $17.42

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Labor						
Skilled Labor	230	Labor requiring a high level skill set: Includes carpenters, welders, electricians, conservation professionals involved with data collection, monitoring, and or record keeping, etc.	Hour	$33.20	8	$265.60
Materials						
Reverse Osmosis unit, variable cost portion	2225	Variable cost portion of a reverse osmosis unit used for maple syrup processing. Materials only.	Gallons per Hour	$17.20	1200	$20,640.00

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Scenario: #13 - Enhanced preheater, small

Scenario Description:

The unit is installed over the evaporator pan and uses steam from the evaporator pan to pre-heat the sap to as high as 200ºF while at the same time injecting air into the sap to promote evaporation. Use for units less than 40 sq ft. Evaporation rates are increased by 65-75%, based on vendor analysis, leading to 40-43% energy savings. Sap is concentrated from Brix 2% to 4% or more before it enters the flue pan. Steam-enhanced systems require at least 9 feet from floor to ceiling. With increased evaporation, it takes less time to boil the sap down, thus saving significant energy (oil & wood fuel) used in the process, as well as labor.

Before Situation:

Existing evaporator uses cold sap at inflow causing long boil times. inefficient fuel use and increased emissions.

After Situation:

Use of a preheater captures waste heat from the evaporator and preheats cold sap and concentrates sap. Boil time, fuel use, and emissions are reduced. Any improvements are based on a Type 2 energy audit meeting the requirements of ASABE S612.

Scenario Feature Measure: Area of pan

Scenario Unit: Square Foot

Scenario Typical Size: 24

Scenario Cost: $9,116.83 **Scenario Cost/Unit:** $379.87

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Labor						
Skilled Labor	230	Labor requiring a high level skill set: Includes carpenters, welders, electricians, conservation professionals involved with data collection, monitoring, and or record keeping, etc.	Hour	$33.20	4	$132.80
Materials						
Sap Pre-Heater, High efficiency, variable cost	2255	High efficiency sap pre-heater device, variable cost portion. Materials only.	Square Foot	$203.41	24	$4,881.84
Sap Pre-Heater, High efficiency, fixed cost	2254	High efficiency sap pre-heater device, fixed cost portion. Materials only.	Each	$4,102.19	1	$4,102.19

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Scenario: #14 - Enhanced preheater, large

Scenario Description:

This unit is installed over the evaporator pan and uses steam from the evaporator pan to pre-heat the sap to as high as 200ºF while at the same time injecting air into the sap to promote evaporation. Use for units 40 sq ft and larger. Evaporation rates are increased by 65-75%, based on vendor analysis, leading to 40-43% energy savings. Sap is concentrated from Brix 2% to 4% or more before it enters the flue pan. Steam-enhanced systems require at least 9 feet from floor to ceiling. With increased evaporation, it takes less time to boil the sap down, thus saving significant energy (oil & wood fuel) used in the process, as well as labor.

Before Situation:

Existing evaporator uses cold sap at inflow causing long boil times. inefficient fuel use and increased emissions.

After Situation:

Use of a preheater captures waste heat from the evaporator and preheats cold sap and concentrates sap. Boil time, fuel use, and emissions are reduced. Any improvements are based on a Type 2 energy audit meeting the requirements of ASABE S612.

Scenario Feature Measure: Area of pan

Scenario Unit: Square Foot

Scenario Typical Size: 40

Scenario Cost: $8,402.00 **Scenario Cost/Unit:** $210.05

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price ($/unit)	Quantity	Cost
Labor						
Skilled Labor	230	Labor requiring a high level skill set: Includes carpenters, welders, electricians, conservation professionals involved with data collection, monitoring, and or record keeping, etc.	Hour	$33.20	8	$265.60
Materials						
Sap Pre-Heater, High efficiency, variable cost	2255	High efficiency sap pre-heater device, variable cost portion. Materials only.	Square Foot	$203.41	40	$8,136.40