JUKKA WASSTRÖM
Sales Manager, White Liquor Plant, ANDRITZ

"Early indicators suggest a capacity increase of a lime kiln by 210 t/d by upgrading to LimeFlash-H can make an investment saving of up to 70% in comparison to installing a new lime kiln."

production, by adding the latest equipment and technology vertically into the ANDRITZ LimeKiln process by using two cyclone systems in the existing building.

New features of the LimeFlash-H include a preheating cyclone (an additional second cyclone) with refractory, a new design of the pressure lock under the cyclone, an elevated operational temperature of around 500 °C in all related equipment after the pre-heating cyclone, and a new lime mud feeding point above the pre-heating cyclone.

"LimeFlash-H can now be considered part of the next generation in solutions for maximizing efficiencies of the lime kiln," says Kottila.

INVESTMENT SAVINGS UP TO 70%

A current LMD lime kiln with a diameter of 3.6 m, a length of 75 m and with a capacity of 300 t/d burnt lime, could see a capacity increase to 510 t/d with the implementation of LimeFlash-H. Major investment savings are made as the lime kiln size remains the same, and there are no requirements for civil works.

This represents a capacity increase of 40%, at the same time as running with ultra-efficient heat recovery using the LimeFlash-H two-cyclone system. Further advantages include the lime kiln operating with a higher feed head temperature, flexibility to operate with different process conditions, minimum maintenance, and excellent availability.

"Early indicators suggest a capacity increase of a lime kiln by 210 t/d by upgrading to LimeFlash-H can make an investment saving of up to 70% in comparison to installing a new lime kiln," says Jukka Wasström, ANDRITZ Sales Manager, White Liquor Plant.

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"We have been engaged in a lot of development work since the first delivery of the LimeFlash technology in 2007. This has included solving several process challenges and several changes in mechanical structure, including modifying the duct shape from round to square."

MIKA MUSSALO
Head of Product Management, White Liquor Plant, ANDRITZ

SMALL CHANGE BIG DIFFERENCE

ANDRITZ has created a simple but remarkably effective way to improve energy efficiency of the pulp mill, at the same time increasing the mill overall evaporation capacity. The DEvap is a small digester evaporator unit integrated into the cooking plant.

Pulp mill process experts at ANDRITZ are constantly looking for ways to optimize energy consumption mill-wide. One of the latest innovations is the DEvap, a mini digester evaporator that generates secondary steam which is used for heating chips in the digester instead of fresh steam. The DEvap concept can be as part of a greenfield pulp mill or alternatively retrofitted into an existing cooking plant.

Arttu Klemola, ANDRITZ Sales Manager, Evaporation Plants, says, "In a traditional digester and cooking plant, fresh medium pressure steam is used in the digester top to heat up the chips and cooking liquor to the temperature needed. This steam then condenses inside the digester which then needs to be evaporated in the evaporation plant.

"When the DEvap digester evaporator is integrated into the fiberline, 100% of the direct steam to the digester top is replaced by secondary vapour. This makes a big difference when it comes to energy efficiency. Secondary vapour is generated by evaporating part of the black liquor from digester extraction screens with DEvap. Medium pressure steam is used in the DEvap, instead of in the digester top. As the medium pressure steam no longer condenses inside the digester, the dry solid content of the black liquor going to the evaporation plant is increased and therefore less capacity is needed in the evaporation plant."

Reduction in needed evaporation capacity depends on digester steam consumption. In modern mills, DEvap decreases black liquor flow to evaporation by 3–5%. In greenfield mills, DEvap enables a smaller evaporation plant with less steam consumption.

In direct steam batch cooking plants, medium pressure steam used for heating can be replaced with steam generated in a DEvap. Some of the black liquor going to the evaporation plant is led to the DEvap via the economizers. The benefits are the same as in continuous digesters: higher black liquor dry solid going for evaporation leads to reduced steam consumption in the evaporation plant and lower boiler water consumption.

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Displacement batch cooking plants use direct medium pressure steam in the pressure controls of the accumulators and the final cooking temperature adjusting in the heating sequence of the digester circulation. All these steam inlets can be replaced with steam generated by DEvap.

In retrofit cases, reduction in needed evaporation capacity can add up to almost 10%, which can be very beneficial especially if the existing evaporation plant limits mill capacity.

BENEFITS AND PAYBACKS

Due to the increased efficiencies and energy saved using secondary steam, the return on investment on the DEvap is very short, just 1–2 years. Lasse-Matti Björkstedt, Development Manager, Evaporation Plant, says, "The benefit of the digester evaporator is that the condensate of medium pressure steam is collected, not condensed on the chips and black liquor, and can be sent back to the boiler feed water system. This condensate has significant value in terms of feed water preheating and demineralization costs, which, added to the reduction in steam consumption in the evaporation plant, means major pay backs."

For a mill the size of Metsä Fibre's Äänekoski bioproduct mill, the steam flow to the top of the digester is around 15 kg/s. If this steam is generated via a DEvap instead a direct MP-steam, the water flow in weak black liquor is correspondingly lower, resulting in 15 kg/s less water to be evaporated. Also the steam condensate can be returned to the power plant, as the direct steam input is replaced with a secondary vapor from the DEvap. In case of a direct steam feed, the lost amount of steam condensate would be replaced with demineralized water to maintain the required amount of water/steam in the power plant circulation.

A steam economy of a modern 7-effect evaporation plant is normally about 6 tonnes of evaporation per 1 tonne of steam, so the LP steam saving in the evaporation is 15 kg/s ÷ 6 = 2.5 kg/s.

The DEvap uses around 1 t/t steam for evaporation and thus the returned condensate amount is about the same as the evaporation, in this case 15 kg/s. The condensate from DEvap is at the saturation temperature of MP steam, which is normally around 170 °C. The saving here comes from the temperature difference of the returned condensate (in the case of a DEvap) and the demineralized water (in the case of direct steam feed). The demineralized water temperature is normally around 40 °C. This heat difference is balanced in a feed water tank, where the mixture of returning condensates and demineralized water is heated to a temperature required for the boiler, so returning the hot condensates instead of cold demineralized water will save LP steam flow to the feed water tank.

The saved heating power in the feed water tank is about 15 kg/s × 4.19 kJ/kg°K (170 °C–40 °C) = 8,170 kW.

The corresponding steam saving can be estimated by dividing the heat power with an approximate condensation heat of the steam: 8,170 kW ÷ 2,150 kJ/kg = 3.8 kg/s

The result is a total steam saving of around 2.5 + 3.8 = 6.3 kg/s.

As the process does not need this steam flow now, it can be fed to the condensing part of the turbine and thus generate more electricity.

The gained electricity in the condensing part of the turbine is normally around 450 kJ/kg, so the electricity generated with the saved LP steam is around 6.3 kg/s × 450 kJ/kg = 2,835 kW.

Thus the annual savings are the extra generated electrical power multiplied with the annual operating hours and the price of electricity: 8500 h/a × 2.835 MW × 45 €/MWh = 1.1 MEUR per year.

DEvap digester evaporators are built in the usual ANDRITZ robust style using its lamella evaporation technology. Tuuli Oljakka, Technology Director, Evaporation Plant, says, "The advantage of lamella technology is its inherently non-scaling heating surface; there are fibers in the liquor from the cooking process in the fiberline. Using lamella technology means there is no extra washing required of the heating surface."

REFERENCES:

A DEvap digester evaporator has been successfully installed at Metsä Fibre's bioproduct mill, Äänekoski, in Finland.

Another confidential customer recently ordered an DEvap system to be used for debottlenecking and increasing the mill's evaporation plant capacity at its mill in Austria.

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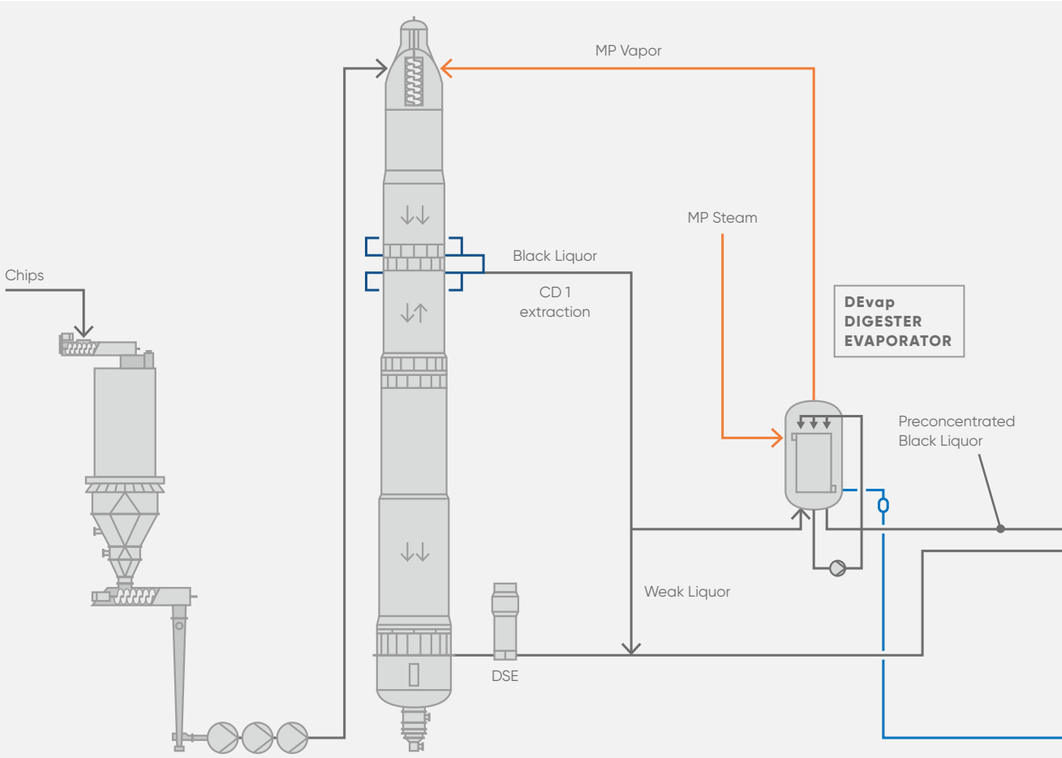

BENEFITS OF THE DEVAP DIGESTER EVAPORATOR

- Direct steam to digester top replaced by secondary vapor
- Higher black liquor dry solids content to evaporation
- Smaller heating surface in the evaporation plant in greenfield cases
- Smaller steam consumption in the evaporation plant
- Increased return rate for primary condensate as no more mixing direct steam with black liquor inside the digester
- ANDRITZ lamella evaporation technology

ANDRITZ DEvap at Metsä Fibre Äänekoski in Finland