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Recommended dryer differential pressures

Scope

This Technical Information Paper provides guidelines for establishing operating differential steam pressures for conventional paper machine dryers.

Safety precautions

Follow normal safety precautions when working around paper machinery. Do not allow loose clothing or equipment to contact rotary machinery or ropes. Beware of thermal and slip hazards around the dryer section. Avoid direct contact with hot surfaces. Use hearing protection in noisy areas. Eye protection should be worn in all production areas. Safety shoes and safety helmets should also be worn where required.

Introduction

During normal paper machine operation, a difference in pressure between the dryer steam supply and condensate return headers ("differential pressure" or "DP") is required to remove condensate from the dryers. A steam and condensate system is responsible for maintaining these differential pressures. This TIP provides a review of the theory of condensate evacuation and offers guidelines for the selection of the operating differential pressures. These guidelines apply to properly sized siphons and equipment. In some cases, steam systems are designed to operate outside the range of these guidelines. Care must be taken to ensure that the operating differential pressures match the design of the steam and condensate system.

Condensate behavior

The DP that is required to achieve stable condensate evacuation depends on the behavior of the condensate in the dryer. The condensate may be in a ponding, cascading, or rimming condition (*1-2*). The condition depends on dryer speed, steam pressure, dryer diameter, and volume of condensate in the dryer. For example, if the dryer is rotating slowly, the condensate will run down the dryer shell and form a puddle at the bottom of the dryer. This is called the "ponding" condition. As the dryer speed is increased, the condensate begins to fall away from the rotating shell, back toward the bottom of the dryer. This is called the "cascading" condition. At a higher speed, generally over 300-350 mpm, the condensate will be rimming with the dryers. The siphon performance curve for a stationary siphon under typical operating conditions is shown in Figure 5.

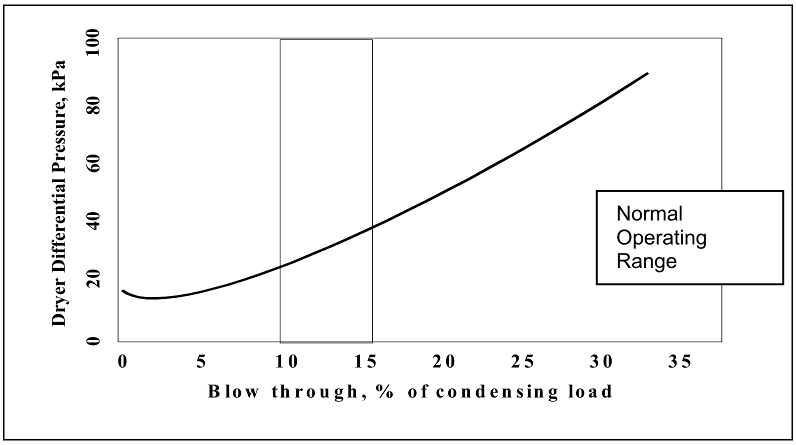

Figure 5. Stationary Siphon Performance Curve
(Conversion factor: psi = kPa x 0.145)

This figure shows that the amount of blow-through that passes through a stationary siphon will increase as the differential pressure is increased. The volume of the blow-through steam decreases as the dryer steam pressure increases, as shown in Figure 6. This decrease in density reduces the frictional resistance. As a result, the amount of blow-through will increase, if the condensing load remains constant. The amount of blow-through also increases as the condensing load is reduced. This is also because of the reduction in frictional resistance. Typically, the blow-through steam for a stationary siphon will be 10-15 % (mass basis) of the condensing load.

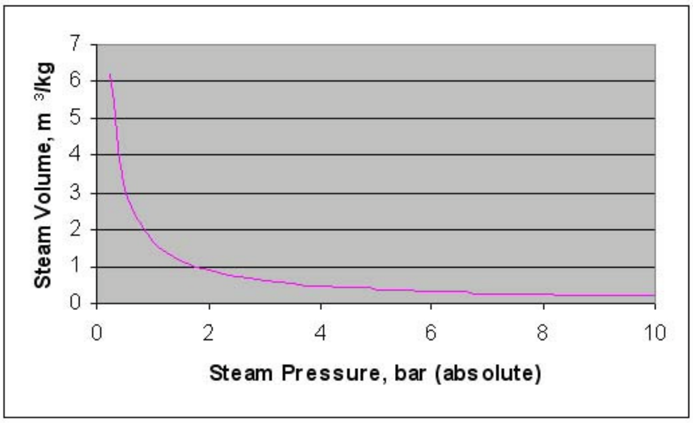

Figure 6. Steam volume as a function of the steam pressure.

When the condensate is in a rimming condition, its kinetic energy can be used to push the condensate up from the inside surface of the dryer to the center of the siphon discharge pipe. With increasing speed, this kinetic energy can reduce the required differential pressure. At high machine speeds, condensate can be removed without any differential pressure, except for that required to maintain minimum blow-through flow to ensure removal of non-condensables and evacuation of the dryer during slow speed conditions.

Because of this phenomenon, the stationary siphon can be applied over a wide range of machine speeds, from a ponding condition to high-speed rimming conditions.

For properly sized stationary siphons with matching steam and condensate systems, the operating differential steam pressure will normally be 15-35 kPa (2-5 psi).

Keywords

Dryers, Siphons, Pressure gradient

Additional information

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