

Corrugator steam systems

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A description of seven systems that provide steam to heat the corrugator.

Steam supplies the heat to the corrugator. Heat is necessary to properly form the fluted structure of the corrugating medium and to gelatinize the starch to bond the medium to the facings of linerboard. The Engineering Committee of the Corrugated Containers Division has compiled this description of seven systems prevalent in supplying steam to the corrugator. The system performs many functions over a wide range of conditions. The seven systems fall into two classes: direct types and cascade systems. Falling into the first category are the S&S, the Donahue, and the Steamguard systems. The cascade systems are Armstrong, United, Langston, and Stickle. This paper is not intended as an endorsement of any system; rather, its objective is to provide descriptions of the systems commonly used.

The information is also contained in a TAPPI Technical Information Sheet (TIS 0302-02), available from TAPPI PRESS.

Introduction

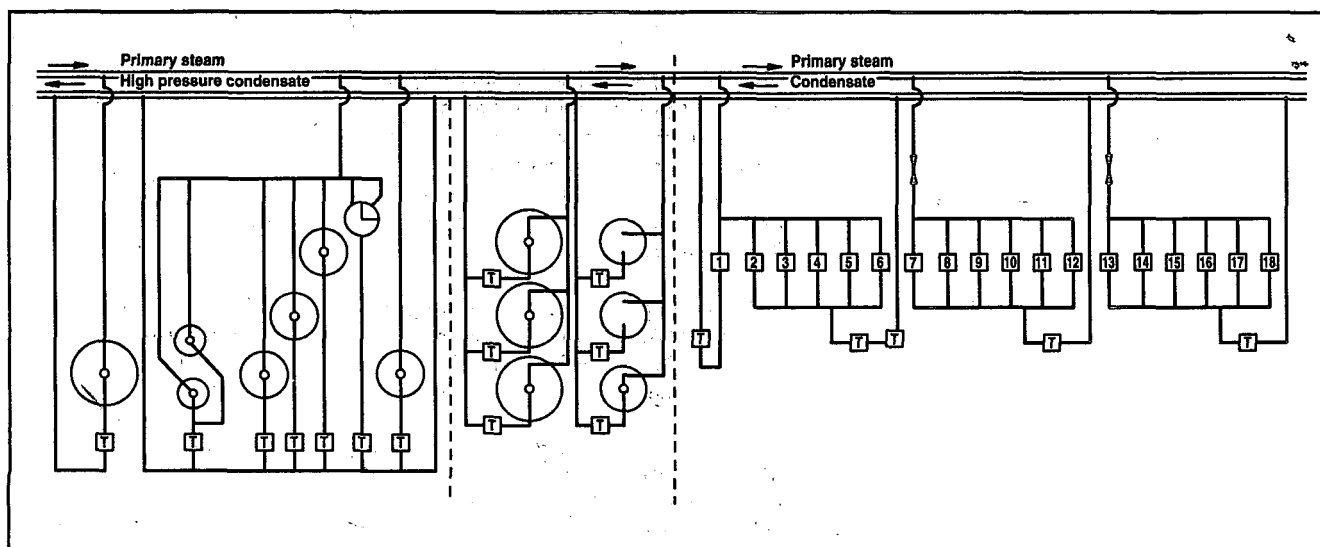
A number of types of steam systems are available for a corrugator. The objectives of a good steam system should be taken into consideration before choosing which is best for a particular operation. A steam system should:

- Deliver dry steam at the desired pressure to every vessel
- Continuously remove condensate as it forms
- Deliver low-pressure wet shower steam to precondition the medium
- Provide some means to purge noncondensable gases (primarily air) from the system, especially during startup
- Automatically handle large heat load variations ranging from the corrugator stopped to the corrugator producing heavy weight double- or triple-wall at high speed
- Accomplish these functions reliably with minimum maintenance requirements.

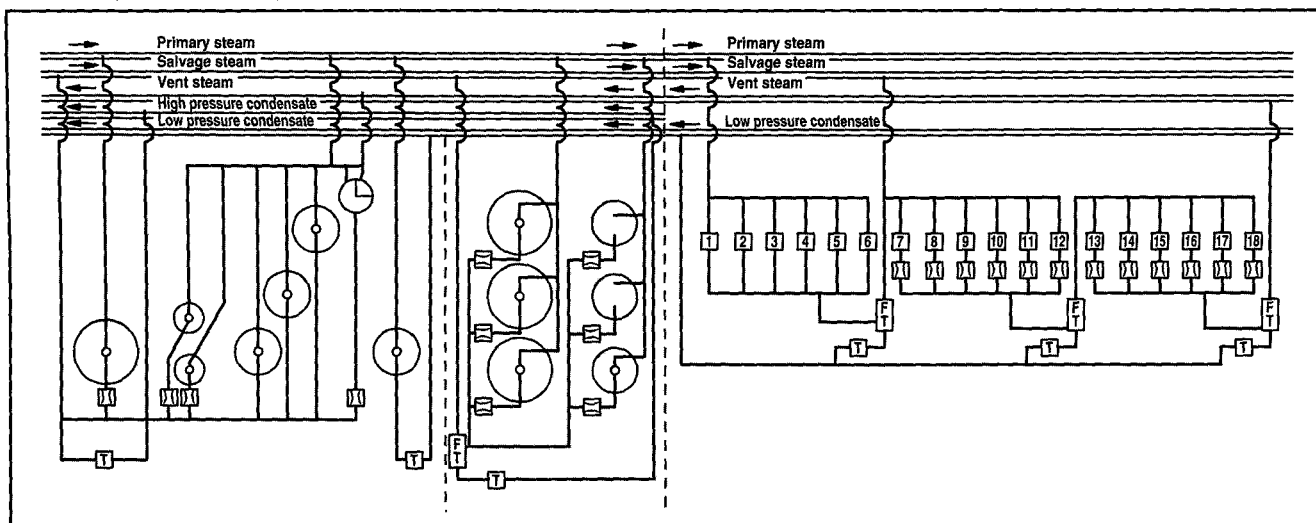
There are two general classifications of steam systems. They are:

1. Direct types (S&S, Donahue, Steamguard). With this type, all vessels are supplied with high-pressure primary steam.
2. Cascade types (Armstrong, United, Langston, Stickle). With this type, steam is passed through the vessels on the wet end and reused on the dry end.

1. An example of a direct system



2. An example of a cascade system



Variations of each system are common. The descriptions that follow will cover the basic concepts of seven common systems.

Direct type systems

S&S

The S&S system requires two main headers: one for primary steam supply and one for condensate return. All wet-end vessels are supplied with primary steam and are individually trapped, except the two small SFL preheaters that share a trap. All traps are Armstrong bucket type.

All condensate is piped to the condensate return header. The Gaylord shower is supplied with high-pressure steam. There are no special provisions to vent noncondensable gases.

On the dry end, the first plate is supplied with primary steam and is individually trapped. The next five plates are supplied with primary steam and are drained into a common trap. The last two sections are supplied with reduced pressure steam (if desired) through thermostatically controlled pressure-reducing valves. Each of the last two sections utilizes one trap for draining condensate.

Donahue

In the Donahue system three main headers are required: one for primary steam supply, one for high-pressure condensate return, and one for low-pressure condensate return. All wet-end vessels are supplied with primary steam and all are individually trapped.

Shower steam is provided by tapping the condensate line between the SFL preheater and its trap. This pulls out a combination of both wet steam and condensate, which is passed through a flash tank to remove the liquid prior to delivery to the medium shower.

A trap on the flash tank collects the condensate and delivers it to the low-pressure condensate return because the shower steam system pressure normally is less than that of the high-pressure condensate. All the remaining wet-end traps are drained into the high-pressure condensate return.

On the dry end, the plates are divided into three sections and each is piped the same. There is a thermostatically controlled pressure-reducing valve on the supply line to each section and each section is drained into a common trap. Each of these traps is piped to an automatic three-way pressure control valve, which delivers condensate to either the high-pressure or low-pressure condensate header depending on the hot plate operating steam pressure.

A ball and linkage system provides continuous drainage of condensate to match the required flow. This trap also has a thermostatic element that automatically vents noncondensable gases.

Steamguard

The Steamguard system requires two main headers: one for primary steam supply and one for high-pressure condensate return. All wet-end vessels are supplied with primary steam and all are individually trapped. Shower steam is supplied by mixing primary steam with condensate return to allow control of pressure and moisture.

The first section of plates on the dry end is supplied with primary steam. The remaining two sections use thermostatically controlled pressure-reducing valves to reduce operating pressure and temperature if desired. Each plate is individually trapped.

The Steamguard trap is not exactly a trap but it functions like one. It allows condensate to pass but restricts the flow of steam. This device, which has no moving parts, is a specially designed stainless steel venturi.

Cascade systems

Armstrong DC (differential control)

The Armstrong DC system requires three main headers: one for primary steam supply, one for salvage steam, and one for condensate return. All wet-end vessels are supplied with primary steam and all are individually trapped with Armstrong DC traps.

The DC trap is basically a bucket trap fitted with an additional outlet including a needle valve. When opened, the valve creates a

differential pressure that forces a continuous flow of steam and condensate through the trap. A standpipe arrangement connected to this outlet removes only the steam that is reused downstream while allowing the condensate to collect until the bucket is filled and the trap cycles. The objective of this trap is to drain condensate and provide a controlled pressure drop across the vessel to ensure a continuous good flow of steam, condensate, and noncondensables.

The double facer is divided into three sections, typically six plates each. The six plates in the first section are supplied with primary steam and individually drained into DC traps. Condensate is drained and delivered to the condensate line while the blow-through steam is collected and delivered to the salvage steam line for use on the last two sections.

These last two sections are supplied by salvage steam supplemented by primary steam through a differential pressure control valve. If the salvage steam pressure drops too low, primary steam will automatically be added to maintain sufficient pressure. The plates in both of these last two sections are individually trapped with conventional Armstrong bucket traps.

United

In the United system, all vessels on the single facers are supplied with primary steam. The steam passes through the rolls, then the condensate and steam combination is collected in a common header and delivered to a flash tank/separator where condensate is removed. The dry steam is delivered to the salvage steam line for use downstream and for showering the medium.

The triple-stack preheaters are supplied with primary steam and are individually trapped. The three vessels on the glue machine are supplied with salvage steam and are individually trapped.

The United dry end is unique among corrugator steam systems. The double backer is divided into five sections: the first three sections contain three plates each, section four has four plates, and section five has five plates. The objective is to divide the condensate flow in each section into roughly equal parts as more heat transfer occurs in the first part of the double facer than at the end.

The first two sections can be supplied with either primary or salvage steam through a piping arrangement using manual valves. However, there is a risk of inducing back pressure in the salvage steam line if too much primary steam is used. The remaining sections are supplied with salvage steam.

The plates in each section are piped in series. This unusual feature means that steam and condensate cascade through each plate until the last plate in each section, where the condensate is drained into a trap. The advantage of doing this is the great deal of turbulence and scrubbing action that improves heat transfer and purges noncondensables.

Langston

The Langston system utilizes five headers: one for primary steam, one for salvage steam, one for vent steam, and one each for high- and low-pressure condensate return lines.

All wet-end vessels, except for the preconditioners, are supplied with primary steam. The preconditioners are supplied with reduced-pressure steam by means of a manual pressure regulator. Each

preconditioner is trapped, with the condensate draining into the low-pressure condensate return.

The outlets on all the other wet-end vessels are piped into flash tank/separators. There is one for each single facer and one for the glue machine area. These flash tank/separators deliver dry steam to the salvage steam line and condensate to the high-pressure condensate return line.

Most of the vessels on the wet end contain orifices in their drain lines to control the amount of flow through and to provide adequate pressure differential for condensate removal. The corrugating rolls and pressure rolls do not have orifices; this ensures maximum flow and heat transfer.

The first section of the Langston dry end is fed with primary steam and is drained into a flash tank/separator. The reduced-pressure dry steam from the separator is combined with the salvage steam from the wet end to supply the second section. This second section is drained into a flash tank/separator. The further reduced-pressure dry steam from the separator is used for the third section supply. Orifices in the drain lines from each plate in the last two sections restrict the flow and maintain pressure balance.

The steam exiting from the last flash tank/separator is delivered into the vent steam line for use as shower steam.

Stickle

The Stickle system utilizes four headers: one for primary steam, one for salvage steam, one for vent steam, and one for a high-pressure condensate return. All vessels on the wet end are supplied with primary steam and are drained into Stickle separators, one for each single facer and one for the glue machine area.

The Stickle separator collects condensate and returns it to the condensate return line while passing dry steam to the salvage line. It accomplishes this by utilizing a float to maintain a liquid level of condensate within the device. As the float rises, a valve opens to discharge some of the condensate to the return line. With this system, no live steam is transmitted into the condensate return.

The first section of plates is supplied with salvage steam. However, by design there is not enough salvage steam available to supply the demand. This is purposely restricted by orifices in the drain lines of the wet end vessels. The demand for steam is satisfied by supplementing it with primary steam through a differential pressure valve. Whenever the pressure level in the first section drops 5 psi below the set point, primary steam is added to maintain desired pressure. The idea behind this design is to provide a controlled differential pressure across the wet-end vessels to ensure consistent steam flow while controlling pressure to the double facer.

After passing through a Stickle separator that drains the first section, the dry steam is delivered at a lower pressure to the second section. The process is repeated for the third section. The steam exiting the third separator is delivered to the vent steam line, which is returned to the wet end for showering the medium. If a plant uses little or no shower steam, a manual valve is provided to open this line into the condensate return line to prevent water logging. **17**

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