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Design, Operation, Performance Evaluation, and Inspection guidelines for Yankee Hood Systems

Scope

This Technical Information Paper (TIP) provides general guidelines for the operation, performance evaluation, inspection and maintenance of Yankee hood air system. Effective application of these and process fine tuning could result in improved safety, reliability and economical operations.

Purpose

Understanding and optimizing a Yankee hood and air systems will:

- Create a uniform and efficient drying environment
- Reduce operating cost
- Reduce risk of injury or fire due to hot air blow outs from hood
- Provide guidelines for safe operation

The drying energy is provided by steam condensing inside the Yankee cylinder, with the balance provided by hot air blown onto the sheet by the hoods while on the cylinder. This publication describes the equipment and processes responsible for supplying dry, heated air to, and removing humid exhaust air, from the Yankee hoods on a typical Yankee dryer.

Limitations

While Yankee hoods are generic in their function, their designs can be quite different. The materials of construction, type or style of installed equipment and principle of operation varies from machine to machine. Due to their varying designs, universal inspection criteria are not practical. The following guidelines for safe, reliable, and economical operations must be considered along with the mill's experience, knowledge of hood's design, and the age of the equipment. Hood inspection criteria will evolve over time as the mill gains the experience from previous inspections. Each hood system will have a unique inspection frequency based on this myriad of variables, and Original Equipment Manufacturer (OEM) specifications should therefore be referred to.

Safety precautions

Even though the writers of this TIP have documented herein the best and most current technology and best practices, neither TAPPI, nor any of the committee members guarantee the completeness or the accuracy of any TIP.
The user assumes all responsibility in the implementation of the design, operation, performance evaluation and troubleshooting guidelines presented in this TIP.

Working around Yankee hoods is inherently dangerous. Hazards include fire, explosion, asphyxiation, heat exhaustion, burns, falls, and cuts. Internal inspections require confined space entry and the provision for confined space rescue and air monitoring.

Below are the minimum safety requirements when working around Yankee hoods. Occupational Safety and Health Administration (OSHA) safety rules will always take precedent.

1. Hood systems vary widely in design and risk exposure. It is important that a detailed risk assessment is completed prior to internal inspections, or repair work, on Yankee hood systems. A qualified safety person, and/or a qualified maintenance engineer, should complete the risk assessment well in advance of any inspection or repairs. Once the risk assessment is complete, the proper permits, personnel, personal protective equipment (PPE), and procedures can be put in place based on the unique safety policies of the mill.
2. There are mechanical and thermal hazards that require the utmost care and respect in order to prevent injuries.
3. Rotating equipment, nip points, slippery walkways, etc., are some of the mechanical hazards present around the Yankee dryer hood
4. Blowouts, fires, hot surfaces, steam leaks, etc., represent thermal hazard sources.
5. Dryer explosion, due to both internal and external cylinder problems, have been documented in different mills worldwide.
6. Some hoods are designed with “walkable roofs.”. Extreme caution must be exercised when walking on the hood roof. Crane lock-out and fall protection are minimal requirements. Newer design rounded hoods are not meant for walking access without further fall prevention measures.
7. Proper asbestos abatement is required when modifying ductwork on older hoods constructed out of asbestos panels as well as removal of insulated panels from hoods constructed prior to 1967.
8. Tissue production creates dust which increases the risk of fire. Good housekeeping with an appropriate fire suppression system is a must.

Definitions

Dryer hoods -Design

A typical Yankee hood or air cap is an enclosure which wraps around the Yankee cylinder and is built in two halves or as one piece without opening/closing mechanism. Each half includes an integral air flow distribution system consisting of a main supply header, feeds and perforated nozzle boxes. Some older design uses narrow slots. The function of the nozzles (or slots) is to blow hot air directly on the sheet, while on the cylinder, with a certain velocity in order to cause moisture to evaporate from the sheet. Spent air is removed through a series of exhaust slots or larger diameter holes. These slots, or holes, lead to a centrally enclosed plenum, under negative pressure. Moisture removal is a function of supply air temperature and impingement velocity. The type of hood also determines the energy requirement and the specific air consumption to support the design production rate. The drying process combination of cylinder and impingement drying is very intensive with high evaporation rates and substantial energy consumption.

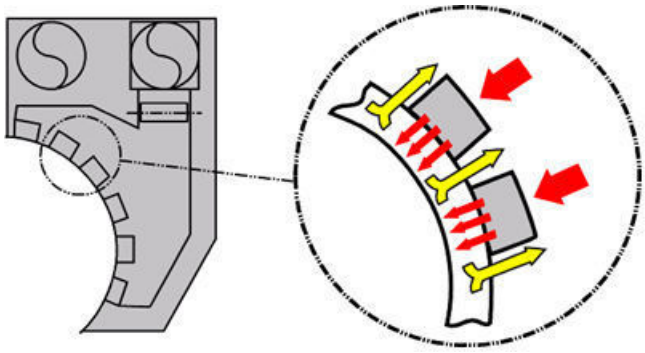

Figure 1. Supply nozzle box and Exhaust plenum

Hood Types

There are different types of hood designated by their supply temperatures. Although all types provide the same basic function to meet specific drying rate, the metallurgy varies depending on the supply temperature. Yankee hoods require insulation on all surfaces with thickness and density proportional to the operating temperatures. As a rule of thumb, one inch of high density insulation is required per 100ºF (38ºC) of design supply temperature

High Temperature: The hood is typically fabricated from austenitic SS alloys such as SS316 and are designed to operate at a supply temperature greater than 1,000ºF (538ºC). High Temperature Hoods offer higher drying and production rates and higher fuel consumption but reduced supply fan horsepower.

Intermediate Temperature: Similar in construction to the High Temperature Hood but fabricated from alloys such as Corten which is limited to 1,000ºF (538ºC). The hood wet end lower tip is normally fabricated from SS ferritic grades. This hood design is the most conventional since it provides balanced electric and fuel energy consumption.

Low temperature (Steam-Heated or Canopy): Steam-heated hoods operate at lower temperatures. Since most of the sheet drying energy is provided by steam condensing inside the dryer, the hood contribution becomes less significant**.** One of the most common problems associated with steam-heated hood is the dust build up inside the ductwork due to supply temperature which falls below the auto ignition of paper which is approximately 450ºF (232ºC).

Canopy hoods designed only to exhaust humidity evaporated by Yankee dryer. They have no drying capacity. In these systems, hot air is used to avoid water condensation into the hood.

Combination of above types are also possible (one type for wet end, different type for dry end).

Hood Air Systems Components

Yankee hood air systems are used extensively in the manufacture of mostly tissue paper. The systems have their air processing arrangements located normally on a mezzanine floor. Typical process air systems arrangements are comprised of combustion chambers, combustion blowers, circulating/supply fans, exhaust fans, heat recovery units, motors and bulky insulated duct work. This equipment requires a large floor space for installation.

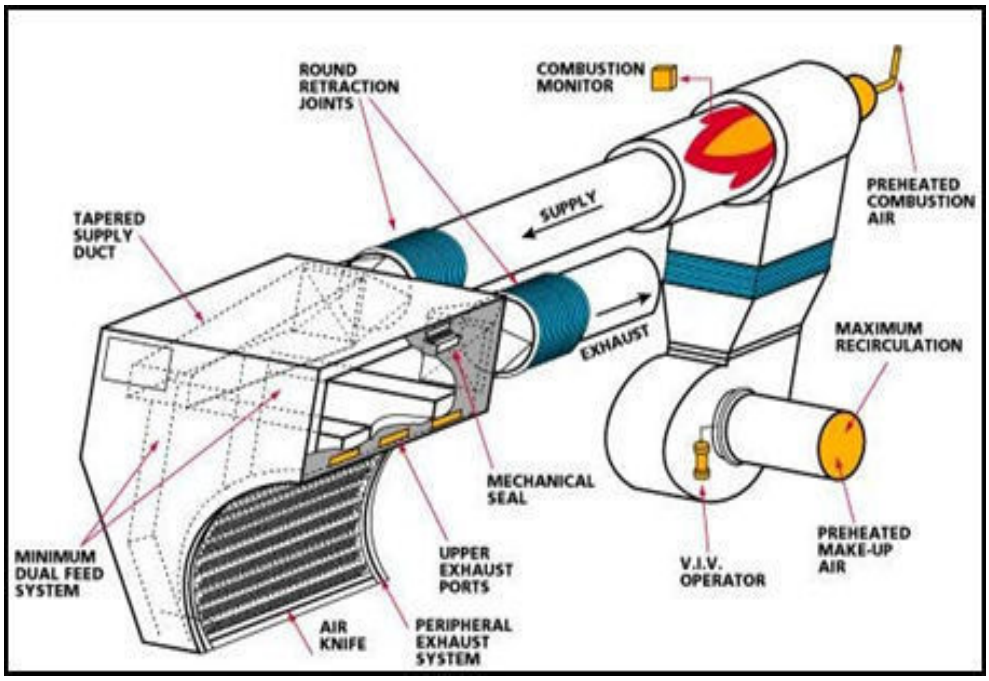

Figure 2. Process Air Systems

Process Air Systems

Parallel System: The most common process air system is the circulating dual burner, or parallel, system. Each hood half is supplied by a burner, combustion blower and a supply (circulating) fan. Both hoods normally share a common exhaust fan. Some mills use separate exhaust fans for each hood half. The main advantage of a parallel system is the ability to continue production, at a reduced rate, should one of the system components fail.

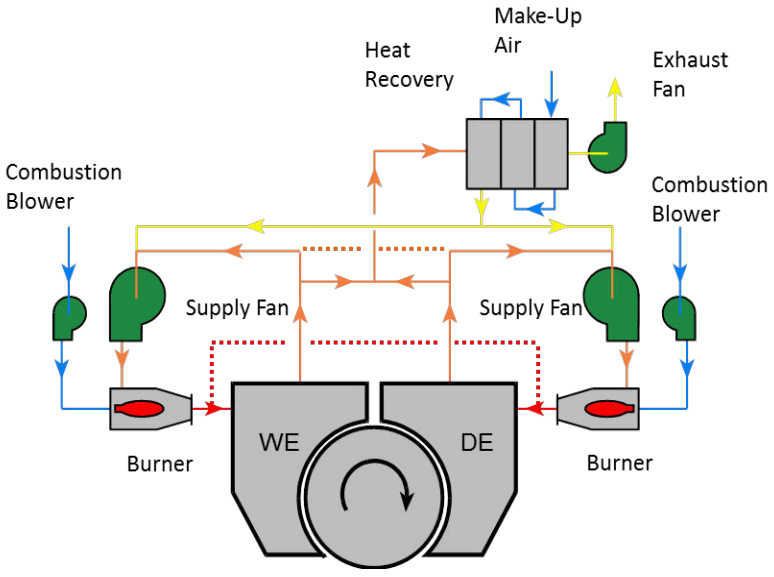

Figure 3. Parallel System