LINT CONTROL IN COTTON MILLS

INTRODUCTION

Lint and fly are major, ongoing housekeeping problems in cotton mills. Lint control is essential. As lint accumulates it tends to clog bearings, guide wires, travelers, bobbins, rolls and other moving or lubricated machine parts. It can even accumulate on rotating parts putting them out of balance leading to friction and ignition. Lint contributes to small particles, called “motes,” in finished products. Avoiding lint buildup is essential in preventing fires, because lint provides an ideal fuel and path for a hot, fast-spreading fire. Burning lint tends to float suspended in air currents. The proper control of lint through better, aerodynamic, machine design makes high operating speeds possible.

The place to control lint and fly is at its point of origin. Cotton mills have installed extensive air filtering equipment to meet OSHA cotton dust standards for employee air quality. These restrictions also benefit the facility’s overall loss prevention. Filtering or cleaning machinery is either associated with the stock conveying machinery or is part of the air conditioning system. Air conditioning systems usually have a fabric type filter for removing lint. Proper conditioning of the air to the correct temperature and humidity enhances product quality and fiber handling.

There are three automatic lint removal systems: the “stand-alone,” “master air handling” and the “integral.”

Stand-alone lint collection systems are designed into the production machine, such as a ring spinning frame or roving machine, and they have perforated openings (flutes) located in areas where lint generally is generated. These systems have on-board filters and lint collection boxes which most often must be manually emptied, although some automated collection systems which can empty these boxes are in use.

Master air handling systems use a portion of the air filtration capacity from the room air conditioning and lint filter system to remove lint from individual machines through a system of ducts and flexible pipes.

The integral systems use a combination of pneumatic stock conveying blowers and exhaust (lint removal) blowers to convey the stock and to perform a cleaning operation. These systems can maintain the critical internal aerodynamics for high speed carding or for efficient cleaning operations. Typically, these systems are self-contained and independent from the room air handling system.

POSITION

Lint Pickup

Three lint pick-up systems are addressed below, the stand alone, the master air handling and the integral.

Stand Alone

The following guidelines apply to stand-alone systems with a separate suction and collection filter installed on each machine:

- Empty lint collection boxes as needed into containers and put them in a safe location. Do not permit large quantities of lint to build up in open tote boxes or other open receptacles in production areas. Loose lint will burn with almost explosive rapidity.
- Keep spare filters in stock. If fire damages a filter on a machine, the filter can readily be replaced with little loss of lint collection or safety.

Master Air-Handling

The following guidelines apply to master air-handling systems having a single master suction fan and separate collection filter installed on each machine. The recommendations for stand-alone systems apply in addition to the following:

- Use metallic, noncombustible ductwork.
- Do not run ducts through any unsprinklered areas of combustible construction, such as spaces under wood floors found in many of the older mills.
- Provide ductwork with inspection/clean-out doors spaced about 25 ft (8 m) apart. This will allow ducts to be inspected and lint fines removed.
- Surround ducts passing through floors with substantial noncombustible watertight collars.
- Do not install ducts through fire walls. If this cannot be avoided, equip ducts with listed automatic fire dampers. Design damper systems so they will not collect waste lint and obstruct the ducts. Fire dampers for round ducts are difficult to design.
- Divert recirculated air to an outside location in the event of a fire. To permit the diversion of air, equip the main duct with automatic pneumatic dampers arranged to operate when a fire occurs. Dampers should be fail-safe and should close when control air is lost.
- Provide ducts with the following protection:
  - Install sprinkler protection inside all ducts over 24 in. (0.6 m) wide.
  - Provide a spark suppression system at wall penetrations inside all ducts less than 24 in. (0.6 m) wide. Provide interlocks for the detection system to shut down the collection system fan.
- Install sprinkler protection under all ducts over 48 in. (1.2 m) wide.

If air from the collection system is fed into the mill air-conditioning system:

- Equip the main duct with pneumatically-operated dampers to divert air from the lint system to a safe outside location in event of fire.
- Install sprinkler heads in the air-conditioning room. Due to temperature fluctuations, heads should be one temperature rating above those normally required for the ambient condition.
- Do not allow the ductwork to expose other manufacturing areas to fire.
- Provide fire dampers at all locations where ductwork passes through fire walls.
- If the area above suspended ceilings is used to return recirculated air, provide sprinkler protection throughout this plenum area.

Install only Class III Division 1 electrical equipment. Use either MI cable or cabling in threaded conduit. Fittings and boxes must be dust tight. Make sure fixtures have gasketed heavy glass globes and outside metal guards.

Mount control switches and indicator lights in watertight enclosures outside the dust room wall. Do not pass wiring supplying electricity to other areas through the dust room unless the wiring meets all requirements for the dust room installation.

Integral

The following guidelines apply to large return air applications with integral central lint collection systems:

- Install a deluge system with open spray heads along both sides of the filter bank and at the top of any flue space.
- Install the heat-actuated devices for the deluge system throughout the dust room and at the top and bottom of any flue. The operation of heat actuated devices should trip the deluge valve and close all dampers and fire doors between the dust room and the opener and picker rooms. If there are trap doors at the top of the dust room flue, they should automatically open to vent the dust room to atmosphere.
- Provide automatic 3-hr rated closures for openings that allow air to pass into the opener and picker rooms.

To adequately protect condenser units, provide automatic sprinklers as minimum protection. These units should also have automatic, infrared actuated dry chemical or gaseous agent extinguishing systems arranged to discharge the system and to shut down the associated air handling systems.

Provide automatic sprinklers at the ceiling of the filter room and install directional (conical discharge) spray heads with a design of 2 gpm/ft² (81 L/min/m²) of filter surface area. Heat shields should be provided.

Drum filter systems, which are part of integral air handling systems (such as those serving a cleaning line), generally have fire protection systems integrated with the protection on other process equipment. This arrangement allows all systems to operate simultaneously and shut down all air handling systems.

Automatic dry chemical or gaseous agent extinguishing systems are essential. Arrange the systems to discharge the extinguishing agent when the sparks are detected in either the incoming or outgoing ductwork. Interrupt the air handling units when the system operates. Generally, these systems use high rates of airflow which delay automatic sprinkler protection and minimize sprinkler effectiveness.

Electrostatic filter systems are generally maintenance intensive and are seldom used in cotton mills. Where used, they usually are located upstream of the water spray system. The electrostatic system fire potential is limited. Follow manufacturer maintenance and housekeeping practices for these units.

Waste Handling

Feed clean waste through a waste picker to loosen the fibers and minimize fibers from wrapping around bearings and rotating machinery parts. The equipment operator should hand feed the short feed apron leading into the waste picker so the operator can scan the material for foreign objects. A rotary magnet installed at the discharge end of the apron should also remove ferrous material before it enters the picker. Sparks from ferrous metal passing through the picker can ignite waste material. Spark suppression systems installed ahead of the waste picker can help keep fire from this equipment.

In order to reduce the incidence of fire, avoid discharging waste directly to the main opener and cleaning line. Instead, the waste machine should discharge to a tote truck or produce the reworked waste in the form of a lap. In some instances, a metal-lined discharge closet can be used. The reworked waste from the picker should be hand fed into a waste feed hopper whose oscillating comb maintains a steady flow of reworked waste into the opener and cleaning line.

Provide a sprinkler head with a heat collector and a separate OS&Y control valve directly over the discharge end of the waste picker or in any discharge closet.

Locate the waste picker in a separate cut-off room. If this is not possible:

- Install a 5 ft (1.5 m) high partition of noncombustible construction around the waste picker.
- Maintain a 10 ft (3 m) clear aisle space between the waste recovery area and any opened cotton or opener machinery.
- Confine all collected waste within the partitioned waste recovery area.

Do not connect the waste picker into the main dust room; use a separate noncombustible lint collector.

The waste house should either be a separate building or cut off from the rest of the plant with a blank, parapeted, masonry firewall of at least 4-h fire resistance. Provide automatic sprinkler protection for the waste house using an Extra Hazard Group 1 design per NFPA 13 and PRC.12.1.1.0.

If the area is heated, provide appropriate hose connections at 100 ft (30 m) intervals. Have at least two 15 or 20 lb (7 or 9 kg) sodium bicarbonate (BC) dry chemical extinguishers available for every 2500 ft^2 (230 m^2) of floor area. Multipurpose dry chemical cannot penetrate as well as sodium bicarbonate.

Install and maintain pit baling presses as follows:

- Separate the pit from any crawl space under the main floor with solid concrete or masonry walls.
- Use Extra Hazard Group 1 design sprinklers to adequately protect all sections of the pit.
- Clean the pit at least weekly or more frequently, if necessary.

When baling, make sure waste is removed from the corners of storage bins. Tightly packed, oil soaked residues could lead to spontaneous ignition.

Proper electrical equipment, good housekeeping and proper maintenance in the waste house should be provided.

DISCUSSION

Lint Pickup

Cotton plant housekeeping has progressed over the years but not without trial and error. At one time mills used electric trolley traveling blowers to blow air at high speeds outward and upward over machinery to keep lint off the overhead surfaces. But airborne lint eventually settled back onto machinery again. To upgrade the blowers, sleeves, called “elephant trunks,” were attached to direct air at the correct speed and volume to critical areas. Lint settled on the floor areas where it could be readily swept up.

Neither system worked well enough; lint control still remained a problem. Finally vacuum systems using fixed vacuum outlets were installed. The concept of vacuum systems worked well and has been further enhanced by trolley-operated vacuum units with flexible sleeves that suction lint at floor levels. The units discharge collected lint from the cleaner into a fixed receptacle. The receptacle can be emptied manually when full or be piped to a vacuum stripper tank in the waste house.

Filter systems associated with stock conveying machinery (chute feed cards) usually consist of a pre-separator (large condenser) and a drum filter. The pre-separator removes most of the lint from the air. Air from the stack filters is then returned to the room or air conditioning system. Lint or fiber from the pre-separator is air conveyed to an automatic collector. Most of this baled waste is sold and not reprocessed. The filtering equipment is protected with infrared spark detectors, automatic dry chemical agents and sprinklers.

Lint control devices, such as automated lint collectors, have been installed on cotton-processing machinery such as opening, picking, blending and carding machines, and roving and spinning frames.

As an example, when yarn is drawn across a scavenger roll on the ordinary spinning frame, the roll picks up loose threads and removes loose fibers, preventing imperfections in the cloth. When an automatic lint collection system is installed, a flute replaces the scavenger roll. The flute has minute openings, one for each thread being spun. Loose ends and fibers are immediately sucked into the flute and passed to the point of collection.

Lint control devices can pick up lint close to its point of origin and recover the relatively clean, long-staple fibers before they settle on machinery or floors. Most of the time, recovered fibers can be reused in the process.

Machines with on-board lint collection systems have fewer fire protection problems if appropriate maintenance and housekeeping measures are used. However, a central lint recovery system or a master air-handling system used for several machines must be carefully evaluated if serious losses are to be avoided, particularly from a production continuity standpoint.

Air handling systems serving an entire room, such as the Master system, or an individual process, such as the Integral system, are similar in that most airborne lint is first removed by a pre-filter or condenser. The pre-filters must either automatically index to expose clean filter media or must have periodic automatic or manual cleaning. The condensers automatically discharge lint which is then pneumatically transferred to a waste baling machine. The partially filtered air from these units then passes through large surface-area filters. The filters efficiently remove most of the remaining lint from the airstream which is then discharged to the room, or to outdoors, or recycled through the process. Air from room air-handling units mixes with outside air and discharges through steam coils and/or chilled water spray to control temperature and humidity. Some mills add another intermediate step of passing the air through electrostatic filters. The filters effectively eliminate the very fine lint from the airstream.

Stand-Alone

A stand-alone lint recovery system with all the potential hazards of a master air-handling system, poses additional hazards:

- Lint from machines passing to the central filter can transmit a fire. The fire can destroy the filter. At that point, all production machines connected to the common duct system will probably be shut down until the filter has been repaired or replaced.
- Fire can also move to the lint recovery point. Depending on the physical nature of the stock, a secondary fire can be more severe than the original and can lead to a production loss in other areas.

Master Air-Handling

There are several potential hazards with a master air-handling system:

- Considerable ductwork can allow fire and smoke to move easily through firewalls. Ductwork can also create floor openings for fire-fighting water to pass between floors of a multistory building.
- Large size ducts used for main trunk lines can obstruct effective overhead sprinkler coverage.
- Filtered air from the lint collection system returned to the mill air conditioning system could distribute smoke throughout the facility if a fire develops on a process machine.
- If the main suction fan is lost due to fire, lightning or other peril, production on all units attached to the system could be interrupted.
- Air conditioning filters collect large quantities of fines which could eventually build up and ignite. A fire involving filters may then move to duct areas downstream of the filters.

Integral

At one time some mills used dust rooms to return air to opener and picker machinery. Today the trend is to use return air filters. Installing an intercepting wall composed of filter units in metal frames will permit filtered air to return through openings to the opener and picker rooms. Air filters are more efficient, conserve heat and control humidity better in process areas.

The need for interior sprinklers in small package units depends on the amount of recovered lint that will normally be found in the unit. In some cases, the amount of lint is so small, it would be consumed by the time a sprinkler head operates.

Waste Handling

Usually, the waste handling depends on whether waste is “clean” or “dirty.” Clean waste is normally reworked into the process; dirty waste is bundled or baled and sold to reprocessing firms.

Waste brought from the manufacturing areas to the waste house is usually placed in separate noncombustible bins according to grade. As waste accumulates, it is baled and stored in the waste house or a separate warehouse for shipment. The waste house usually contains vacuum stripping tanks and their corresponding pumps.

Defective sliver, roving or yarn are the chief sources of clean waste brought from the main mill to the opener or waste room in sliver cans or tote trucks. Although this material is basically unsoiled, it may contain some foreign materials, such as ring travelers, which should be removed before the yarn is reworked. The rope or twisted nature of the materials also creates a tendency for the material to wrap around rotating parts or bearings. This action can cause a friction-induced fire. Depending on the mill’s operations, clean waste from an automatic lint-recovery system and vacuum stripper tanks may also be reworked into the system.

Spontaneous combustion can occur from oily wastes such as floor sweepings. When oil-laden sweepings become tightly packed in the corners of bins with limited ventilation, they may spontaneously ignite.

Portable waste trucks, which are preferred to storage bins, have the following advantages:

- All waste is easily removed from trucks when the trucks are tipped. Less labor and effort is required to handle waste in this manner.
- Housekeeping problems are simplified.
- Fires are usually less severe, because loose stock can be contained in small, segregated and neatly arranged amounts.