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ANALYSIS OF THE EFFECTIVENESS OF PROCESSING SEED COTTON USING RESOURCE-EFFICIENT TECHNOLOGIES

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ANNOTATION
This article discusses the analysis of the efficiency of processing seed cotton using resource-efficient technologies, the technologies used in the initial processing of cotton.

KEYWORDS: cycle schedule, cotton broker, bottlenecks, “fire-packed”, picker lap

INTRODUCTION

The tendency today is to limit cotton storage at the processing mill by scheduling deliveries from the cotton gin on a short cycle basis. The short cycle schedule has saved operating capital, and spacing and has reduced in the fire exposure. Cotton is easy to ignite; it has a fast spreading flame front and an acrid, dense smoke. Cotton fire burrows into bales. Characteristics of burning cotton dictate the need to follow certain design criteria for cotton warehouses. The maximum sizes for warehouse sections generally extend 20 ft (6.1 m) high and span 10,000 ft2 (929 m2) of floor area. Lift trucks unload bales from trucks or freight cars onto a receiving dock that accesses various warehouse sections. To facilitate inspection and sampling of cotton bales, workers occasionally cut a bale tie with a tie-cutter and take samples from opposite sides of each bale. High stacking of baled cotton stresses the ties of bottom bales. Should a tie slip or let go, friction or sparking may ignite the cotton.

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MAIN PART

Quality control of incoming bale shipments has reduced much of the need to test raw materials. When in-house testing is performed, small clump samples from the cotton bales are brought to the classing office in small tote boxes or in small paper wrapped bundles. Samples are checked for staple length and proper grade. Bales within 5% of grade specifications are stored in warehouse sections. Unsatisfactory bales are held in the dock area until they are returned to the cotton broker. At one time, a standard warehouse section was about 5000 ft2 (465 m2), but competitive pressure for labor-saving methods and lower unit costs have forced a trend toward larger and higher one-story warehouse sections. However, larger areas create greater loss possibilities and a need for extended fire protection. At some point, the necessary fire protection becomes an economic burden. Although cotton bales are highly compressed and are partly wrapped in burlap or woven plasticmesh, enough fiber ends are exposed to allow rapid flame propagation over the entire pile of bales. Bales wrapped in plastic sheeting usually contain synthetic fibers.

Although relatively rare today, a “fire-packed” or “hot gin” bale results when a spark or hot ember becomes trapped in the cotton while it is being baled at the cotton gin. Even though the bales are tightly packed, enough oxygen is in the hollow cotton fibers to sustain combustion. A fire can continue to burn within the bale, probably undetected, until it breaks through to an outer surface, sometimes days or weeks after initial baling. As a fire propagates over the surface of the bales, it will burrow into them and continue to burn until water is directly applied to the area. Tightly packed cotton does not absorb water readily, and as a result, “wet” water and sharp pointed nozzles are necessary to finally extinguish a burrowing fire in bales or packed cotton. See NFPA 18 for guidance. Bales of cotton must be overhauled individually before local hot spots can be finally extinguished. Complete extinguishment usually requires removing and opening each bale involved to extinguish deep seated pockets of smoldering cotton.

Opening. Modern cotton gins generally supply clean, consistent cotton; however, debris in the form of dirt, leaf matter, grass, stones, baling wire, machine dust from the ginning process and tool parts from the handling process can be present. The opening process removes stones and machine parts before they damage processing equipment or ignite the cotton. The

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cellulosic matter is removed before it is pulverized and becomes harder to remove. Low impact equipment removes much of the cellulosic debris.

Cotton in bales is tightly matted and highly compressed. Opening machinery loosens and separates the cotton into tufts so it can be effectively cleaned and further processed.

The opener room is one of the potentially serious bottlenecks in a cotton mill. Bales of cotton are brought from the warehouses into the opening rooms. Bale ties and coverings are removed from selected bales. The stripped bales are then laid out and allowed to sit for several hours until they reach room temperature and adjust to the humidity of the area.

To ensure uniformity in the end product, cotton must be blended from several bales to make the size, length and color of the cotton as uniform as possible. This blending process, starting with opening, continues through most processing operations.

At one time, opening and blending operations began with hand-feeding the fiber from the laid-down bales into hoppers, whose spiked conveyors and saw-toothed rollers opened (loosened) the matted fiber. These machines discharged fiber into weigh hoppers which would discharge a mixture of the appropriate blends of fiber. These openers, operating with the weigh hoppers, discharged stock onto a conveyor belt which in turn fed a pneumatic transfer system through the cleaning machinery.

Today, automated equipment takes stock from the opened bales with gantry mounted mechanical fingers. The state-of-the-art opening and blending systems start by laying a row of opened bales of fiber, arranged in the proportions of the desired blend of the end product. An automated opener containing rotating fingers (or saw-toothed shaped rollers) passes across the top of the row and removes the top few inches of fiber from each bale. As the machine passes, the fiber is pneumatically transferred through a channel, adjoining the opening machine track, to the reserve hoppers on the cleaning machinery. High-limit switches on the reserve hopper control the speed of the opening machine as it removes fiber from the bales.

Cleaning

Removing impurities and short fibers from the cotton fiber is essential to ensure product quality and to allow the use of high speed spinning machines.

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The cleaning operations are performed pneumatically and mechanically while the fibers are further separated by spiked rollers and saw-toothed rollers. The dust and light impurities are sucked away while heavy waste is removed by inertial traps.

The efficiency and high speeds of these cleaning machines critically depend on the air flow inside the equipment and the dust removal system. Magnets and metal detectors arranged to open a diversion damper also eliminate metal. These cleaning operations can be performed in cascading single function machines or within one integrated cleaner. The fibers from the cleaning machine then discharge into reserve hoppers or into pre-feedersfor the chute-fed carding operation. Picking Early cotton mills used hand-fed hoppers that transferred stock on slow moving conveyors through opening machines, cleaning machines, and picker machines. Picker machines formed a rolled mat of fiber called a picker lap. Fires in these machines were common and were controlled by sprinklers installed in each hopper.

CONCLUSION

Modern opening systems automatically process stock from the time it is laid out to the time it discharges as sliver from the card machines. Chute-feed systems eliminate manual stock handling, as well as the picker process. In general, lay-down bales are automatically fed into openers connected to various mixers and blenders. The material is then air driven through steel ductwork to the carding process where card lines are fed from individual mixers/reserve hoppers. Usually, hand-fed waste opener hoppers reintroduce usable waste to the process. These chute-fed card systems could easily transport fires throughout the entire process, particularly with the high speed of the equipment.

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