BALED FIBER STORAGE

Table of Contents

Page

List of Tables

1.0 SCOPE

This data sheet covers loss prevention recommendations for bailed storage of natural and synthetic fibers.

1.1 Changes

April 2017. Interim Revison. Information about the use of cement-asbestos construction was removed from recommendation 2.1.3.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Construction and Location

2.1.1 Warehouses should be divided into sections of 10,000 ft^2 (930 m^2) by walls with a fire resistance rating of at least 1½ hours. Under conditions in which the following recommendations are followed, somewhat larger areas are acceptable, particularly for lower piled storage. Under the most favorable conditions, up to 30,000 ft^2 (2790 m^2) would be acceptable.

2.1.2 Warehouses should be of slow burning or noncombustible construction.

2.1.3 Ventilation to clear away smoke is an important aid to manual fire fighting. Smoke vents are effective. One square foot (9.3 dm^2) of vent area for each 50 ft^2 (5 m^2) of floor area is an effective ratio. Spaced about 50 ft apart and arranged for manual operation from roofs, they will help clear smoke and permit effective use of hose streams. Automatic vents should be adjusted to open at a higher temperature than the sprinklers used.

2.1.4 Floor drains or wall scuppers should be provided and the floor, pitched in such a manner as to drain sprinkler water and hose stream water from the area.

2.1.5 The structural design and strength of the building should consider the additional load imposed by bales saturated by sprinkler water.

2.1.6 Outdoor storage is not recommended, but if it is necessary, the following measures are recommended.

- Use first any bales stored outside.
- Limit outdoor storage piles to 500 bales per pile, with a clear space of preferably 50 ft (50 m) but not less than 30 ft (9 m) between individual piles and between piles and buildings. Piles 10 to 15 ft (3.0 to 4.5 m) high are convenient for handling and for weather covering. At the large outdoor storage of uncleaned baled flax straw ordinarily carried at cleaning plants, locate piles at least 200 ft (60 m) from important buildings and 100 ft (30.5 m) from each other and from potential ignition sources. Limit pile size to 300 tons (272,000 kg) and pile height to 20 ft (6 m).
- Provide hydrants and well-equipped hose houses spaced at not over 200 ft (60 m) intervals. No part of the storage should be more than 200 ft (60 m) from a hydrant. Provide water supply for hose streams so that two or four streams can be used, depending on size and number of piles.
- Remove grass and loose combustible material in the vicinity of the piles.
- Prevent access of unauthorized persons by substantial wire fence, keeping the nearest pile at least 50 ft (15.0 m) away from the fence wherever possible.
- Provide watch stations in the storage area, and schedule hourly visits by security personnel.
- Skid bales off the ground to provide ventilation and prevent excessive damage by ground moisture. Cotton storage out-of-doors is subject to weather and mildew damage. A tarpaulin cover of sufficient size to cover the tops, ends, and sides of each pile is satisfactory; it should be securely fastened down. Tarpaulins of fire-resistive canvas are recommended.

2.2 Occupancy

2.2.1 Bales should not be stored above or in the same area with greige or finished goods.

2.2.2 Heights of storage should be limited to assist manual fire fighting and enable sprinkler water to reach the fire quickly. Storage height should not exceed 16 ft (4.9 m). The tops of the piles should be at least 18 in. (0.5 m) below sprinkler deflectors.

2.2.3 Piles should be limited to 500 to 700 bales. Cross aisles should be 6 ft (2 m) wide. Main aisles should be 8 ft (2.5 m) wide. Bales should not be stacked in aisles during warehousing operations.

2.2.4 Some pile arrangements, such as three on end, are likely to be unstable and collapse in a fire. These piles represent a serious exposure to other piles and should have either (a) a separation from height, or (b) the sides fronting on other piles should be stabilized by interlocking bales on sides.

2.2.5 A partition with a minimum fire resistance rating of one hour should be provided between baled fiber storage and areas used for other activities such as grading, bale tie repair, etc.

2.2.6 Baled oily fiber waste is subject to spontaneous heating. These bales should not be stored in baled fiber storage areas.

2.3 Protection

2.3.1 Sprinkler system and water supplies should be capable of providing a density of 0.15 gpm/ft^2 (6.0 dm^3/m^2/min) over an operating area of 6000 ft^2 (560 m^2). Intermediate (212°F or 100°C) temperature rated sprinklers should be used for new construction. Sprinkler operation area may be reduced to 2500 ft^2 (232 m^2) for wool storage. An allowance of 500 gpm (1895 dm^3/min) should be made for hose streams. The protection recommended above is applicable to all storage heights up to 16 ft (4.9 m)

2.3.2 Provide yard hydrants and sufficient hose, shut-off nozzles, and other equipment to make at least two large hose streams available at any warehouse section.

2.3.3 Small hose lines (1½ in.) should be available to reach all portions of the storage area. Such small hose may be supplied from: (a) outside hydrants; (b) a separate piping system for small hose stations; (c) valved hose connections on sprinkler risers where such connections are made upstream of sprinkler control valves; or (d) adjacent sprinkler systems.

Garden hose and nozzles can be used to advantage when extinguishing fires in individual bales. A hollow-pointed probing nozzle to which a small hose can be connected to get water to the interior of a burning bale can be used advantageously.

2.3.4 Organize and train a plant fire brigade, and instruct personnel in the burning characteristics of baled fibers, fire fighting, and salvage. When a fire has been brought under apparent control, do not permit sprinklers to be shut off until all surface and shielded fire has been extinguished and there is no evidence of fire other than smoldering within individual bales. Station a man at the sprinkler control valve to turn the sprinklers back on promptly. Also, have charged hose lines ready for immediate use.

2.3.5 When protection is in accordance with this standard, additional protection of overhead steel and steel columns is not required.

2.3.6 Water supplies for fire protection should be available for a minimum of four hours.

2.3.7 Wet systems are preferred to dry systems because they are more reliable and easily maintained. A sprinkler operation area penalty for dry systems should not be made.

2.3.8 Surface fires in baled fibers are usually not difficult to control, but speed of flame travel requires extinguishers having rapid, broad coverage rather than highly concentrated extinguishing power.

Extinguishers should be provided so the maximum travel distance to an extinguisher does not exceed 50 ft (15 m).

1. Dry-chemical extinguishers using sodium bicarbonate or potassium bicarbonate base powders are recommended. Dry chemical can rapidly control a surface fire on cotton, without requiring cleanup of equipment to prevent damage. The extinguishing effect is due mainly to coating of the fiber with a fire retardant powder. A smoldering fire, however, may result underneath the surface. This must be extinguished with water or by allowing the smoldering cotton to burn itself out in a safe location.

Dry-chemical extinguishers are available in a wide range of capacities. However, the 10, 15, and 20 lb (4.5, 7, and 9 kg) units are most effective for textile applications.

2. Water spray can rapidly control a surface fire. For most conditions a garden hose nozzle on a ¾ in. (19 mm) rubber hose is effective. 1½ in. (38 mm) hose and nozzles should be provided for storage areas.

3. Water pump tank and stored pressure water extinguishers are effective in extinguishing fires involving small quantities of baled fibers. Water pump tanks are available in 2½ gal (9.5 dm^3) and 5 gal (20 dm^3) capacity. Stored pressure extinguishers are available in 2½ gal (9.5 dm^3) capacity. These units have short lengths of hose. Spray nozzles should be provided to prevent scattering of loose cottons by the discharge.

2.4 Ignition Source Control

2.4.1 Electrical equipment should meet the requirements for Class III, Division 2 hazardous locations as defined by the National Electrical Code. Exceptions are noted in this section and in FM standards on electrical equipment in hazardous location and on the National Electrical Code.

2.4.2 Electrical wiring in a baled-fiber warehouse is subject to mechanical injury. Wires should be installed in rigid metal conduit or electrical metallic tubing. The conduit or tubing should be mounted directly on the surfaces of walls, ceilings, or timbers and should not extend through space from beam to beam. Main feeders supplying other areas should not pass through fiber-storage areas.

2.4.3 Spark-producing electrical equipment including switches, push buttons, fuses, circuit breakers, attachment plugs and receptacles should be in dust-tight enclosures, NEMA Type V, Type IX or Type XII.

Attachment plugs and receptacles should have connections for the grounding conductors of flexible cords and should be of the arc-confining type so designed that connection to the supply circuit cannot be made or broken while live parts are exposed. The receptacles should be so located or protected that they will not be subject to mechanical injury.

2.4.4 Motors will seldom be required in warehouses, except for elevators and stackers. All motors should be totally enclosed and nonventilated.

2.4.5 In warehouses where electric stackers are used, the electrical equipment of the stacker should comply with the requirements of electrical equipment Class III, Division 2 locations. In addition, special precautions should be taken to protect all fixed-wiring, lights, switches, and attachment-plug receptacles in the warehouse from mechanical injury by the stacker.

Stackers should be supplied through hard-service cord, Type S, SO or ST, with an extra conductor for grounding the motor frame.

2.4.6 The use of traveling cranes, hoists, and similar material-handling equipment that incorporates bare-contact conductors should be avoided. When used, the equipment should meet the requirements for Class III, Division 2 locations.

2.4.7 Lighting equipment should comply with the requirements for electrical equipment Class III, Division 2 locations. Only fixed ceiling units or short pipe pendants with swivel joints should be used, and they should be mounted for maximum protection from mechanical injury. Cord pendants should not be installed.

Incandescent lights should be in heavy-duty keyless sockets controlled by wall switches. Ordinary fiber-lined brass shell sockets are not acceptable. The lamps and sockets should be enclosed in dust-tight gasketed glass globes protected by substantial metal guards.

Fluorescent lights of the open type (ordinary) may be used for overhead lighting. High voltage series cold-cathode fluorescent lights should not be installed.

2.4.8 Factory Mutual Research Approved lift trucks should be used for baled fiber handling. All four types (electric, gasoline, diesel, and LP gas) may be used, provided they are equipped with safeguards to qualify them for use in Class III, Division 2 locations. A portable extinguisher, preferably a 2½ lb (1.1 kg) dry chemical type, should be mounted on each lift truck.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Use and Characteristics of Baled Fibers

3.1.1 Cotton

Cotton is used primarily for the manufacture of textiles.

Most United States mills use cotton grown in the United States. Bales of American cotton are of three types: gin (country or soft), compressed, and export. Gin bales are used in cotton-growing areas where cotton is delivered directly to the mill from the gin. Compressed bales are commonly used if the cotton is to be warehoused or shipped by rail for domestic consumption. Export bales are prepared principally for foreign shipment.

The weight of a cotton bale depends on the country in which it is ginned (Table 1). U.S. bales weight 500 lb (225 kg); 478 lb (215 kg) of cotton and 22 lb (10 kg) of burlap and bale ties. Their sizes will vary with the type of bale.

3.1.2 Jute

Jute is used principally for carpet backing, burlap bagging, and low-strength twine and cordage. When thoroughly wet, baled jute will absorb somewhat more than its own weight of water. Wet bales expand in the direction from which the compression force was applied in baling, usually breaking the rope fastenings. If piled solidly against a building wall, they are capable of pushing out the wall.

Wet baled jute heats spontaneously and must be opened and dried within a few days if serious deterioration is to be prevented. Fire does not penetrate a tight bale to any great extent but will continue to smolder near the surface. Baled jute bagging or burlap has fire characteristics similar to baled jute fiber. The bales are highly water absorbent but do not swell appreciably.

3.1.3 Hemp and Sisal

Hemp and sisal are used mainly for manufacture of cordage. These fibers include low-density (13 to 22 lb/ft^3) (210-355 kg/m^3) bales of Manila, Wisconsin hemp, Panama abaca, istle, and Mexican, Cuban and Haitian sisal. They also include African sisal and East Indian sisals such as Java, Sumatra and Cantala, in high-density (30 to 40 lb/ft^3) (485-650 kg/m^3) bales. Bales of these fibers will absorb approximately their own weight in water. They will expand but much less than jute. However, dangerous expansion may occur if the tie ropes of high-density bales burst, which is likely when they become wet.

3.1.4 Flax

Flax straw is used principally in the manufacture of cigarette paper and is prepared from flax raised mostly in Minnesota and its neighboring states. The prepared straw is free of any oxidizable foreign material that could introduce spontaneous heating hazard. It is highly susceptible to fire, water and smoke damage. Loss of value for making cigarette paper may be almost total.

Table 1. Sizes and weights of cotton bales

Type of Bale	*Approximate Dimensions*		*Average Wt.*		*Approx. Cubical Content*		*Approx. Density*	
	(in.)	*(m)*	*(lb)*	*(kg)*	*(ft^3)*	*(m^3)*	*(lb/ft^3)*	*(kg/m^3)*
Gin	56×45×28	1.4×1.1×0.7	500	225	41	1.2	12	195
Compressed	56×31×22	1.4×0.8×0.6	500	225	22	0.6	23	375
Export	57×22×21	1.4×0.6×0.5	500	225	15	0.4	32	520
Egyptian	52×18×17	1.3×0.5×0.4	750	340	21	0.6	36	585
Indian	50×18×17	1.3×0.5×0.4	430	195	9	0.3	48	780
Russian	38×29×24	1.0×0.7×0.6	470	210	15	0.4	29	470

Table 2. Bale sizes and densities of jute, hemp, sisal, and flax

Fiber	*Approx. Bale Dimensions*		*Average Wt.*		*Cubical Content*		*Approx. Density*	
	(in.)	*(m)*	*(lb)*	*(kg)*	*(ft^3)*	*(m^3)*	*(lb/ft^3)*	*(kg/m^3)*
Indian jute	18×20×48	0.5×0.5×1.2	400	180	10	0.3	40	650
Manila hemp	23×27×45	0.6×0.7×1.0	275	125	16	0.5	17	275
Wisconsin hemp	26×39×50	0.7×1.0×1.3	545	245	29	0.8	19	310
Mexican sisal	27×36×43	0.7×0.9×1.1	410	185	24	0.7	17	275
Java sisal-Soekamandi	20×24×41	0.5×0.6×1.0	450	200	11	0.3	40	650
Flax straw	16×18×44	0.4×0.5×1.0	142	65	7.3	0.2	19	310
Hindu jute bagging	27×36×48	0.7×0.9×1.2	1,100	500	27	0.8	40*	650

* Also packaged in low-density bales at about 17 lb/ft^3 (275 kg/m^3).

Uncleaned baled flax straw is of low unit value and is commonly stored out of doors in large quantities at plants where it is cleaned and processed for shipment to the paper mills. Storage facilities for prepared straw at paper mills are located indoors under sprinkler protection, although small quantities may be temporarily stored in plant yards during peak seasons.

The size and density of bales of jute, hemp, sisal, and flax vary with geographical origin, as shown in Table 2.

3.1.5 Wool

The term *wool* refers to the hairs of the sheep, goat, rabbit, camel, alpaca, llama, vicuna, etc. These wools are used to make fabrics and carpets. Wools are one of the least flammable of the fibers used in the textile industry. ‘‘Raw’’ wools are compressed into bales and stored in much the same manner as other fibers. Loss experience indicates fires in baled wool are similar to those in other fibers; however, sprinkler operating areas are consistently less. Wet bales are subject to spontaneous ignition and deterioration. Wool bales are not highly water absorbent. Recommendations for other fibers apply to wools.

3.1.6 Synthetic Fibers

Use of synthetic fibers is increasing in the textile industry. Data Sheet 7-1, *Fire Protection for Textile Mills,* presents a more detailed description of these fibers. They are commonly stored in two forms. Continuous filaments are wound on spools or bobbins and packed in corrugated paper boxes. This storage is covered in the FM standards on general indoor storage and rack storage.

In the second form the continuous filaments are chopped into short lengths called *staple.* The staple is compressed into bales, stored and handled the same as natural fibers. The bales may be wrapped with corrugated paper or plastic film or may be packed in corrugated paper cartons to keep them clean. The wrappings do not adversely effect the fire hazard of the bales. When packed in cartons, protection should be as recommended in the FM standard on general indoor storage.

Loss experience indicates fires in baled synthetic fibers are very similar to those in natural fibers. Recommendations for natural fibers apply to this form of synthetic fibers.

3.2 Loss History

The FM System has experienced approximately 150 fires in bale fibers over the past 15 years. Of these fires, 60% were in cotton, 18% were in hemp, sisal, jute and flax, 11% were in wool, and 11% were in synthetic fibers.

Where sprinklers were in service and piping not obstructed, the larger of the losses occurred where (1) cracks in plank-on-timber floors of multistory warehouse permitted upward spread of fire, (2) finished goods or other high valued materials were stored in the same fire area with baled fibers, or (3) sprinklers were shut off prematurely.

Successful fire fighting in all storage required smoke ventilation of the building and application of hose streams to all surfaces of bales that were on fire. Individual bales must be removed from the building interior to permit complete extinguishment. Trained plant emergency organization and good storage arrangement are vital in preventing extensive fire spread. Automatic sprinklers proved to be extremely valuable in preventing extensive damage to storage and buildings.

3.3 Illustrative Losses

3.3.1 Cotton Warehouse Destroyed

Complete destruction of a large cotton warehouse resulted from a combination of adverse factors: fire origin involved storage on both sides of an aisle; fire originated near the remote part in junction of two large dry-pipe systems; delay in starting the fire pump; old sprinkler pipe having a low Williams and Hazen roughness coefficient; abnormally dry exterior of compressed cotton bales; unfavorable wind conditions; and possibly low water level in a gravity tank.

The warehouse had a concrete floor and wood-joisted saw-tooth roof. The compressed bales of cotton were stored 6 bales high to 13 ft (4 m), two bales wide with a 4 to 5 ft (1.2 to 15 m) aisle between each double row of bales. Water supplies were from a 100,000 gal (380 m^3) gravity tank on a 100 ft (30 m) tower and a

manual starting engine-driven 1000 gpm, 100 psi (3800 dm^3/min, 690 kPa) fire pump taking suction under lift from a 100,000 gal (380 m^3) below-grade reservoir. There were no connections to the public mains.

Bales were removed from the piles by driving a garret machine down the aisle, connecting chains to a bale tie, and pulling the bale out into the aisle. During this incident, as a bale was being removed from a pile, a metal bale tie broke and fire was seen to follow as the bale fell to the floor. Prompt alarm was given to those nearby. Attempts were made to extinguish the fire by using dry-chemical extinguishers. However, the fire flashed up and along both sides of the 4 to 5 ft (1.2 to 1.5 m) wide aisle. Before small hose could be used, the fire flashed in east and west direction across the tops of the bales. The fire department was then called. Small hose were put into use. The fire spread quickly and further attempts at manual fire fighting proved futile. People and machines were evacuated and automatic sprinklers were reported to be operating. After some delay, the fire pump was started. However, twenty to forty minutes later, the engine overheated and the pump stopped.

By the time the public fire department had arrived, flames were coming out between the joists at the top of the walls. Hose, supplied from plant hydrants, could supply adequate water to reach the roofs. The roof collapsed some time later and sprinkler control valves were closed. The fire department continued to fight the fire with hose streams and kept it from spreading to other sections of the plant.

Approximately 7,400 bales of cotton were involved in the fire. The warehouse was essentially destroyed.

Investigation subsequent to the loss indicated very poor loss prevention planning. Dry-pipe systems were not maintained and flushed properly. The fire pump driver had a past history of overheating. No inspections of the gravity tank were made to check water levels. Available water supplies were determined to have been marginal.

3.3.2 Jute Torched

Approximately 1200 bales of jute were stored in a warehouse of corrugated iron on steel truss roof and reinforced concrete walls. Bales of jute were stored to 14 ft (4 m) high. The building was protected by dry-pipe systems. Water for fire protection was from three 100,000-gallon gravity tanks and a connection to the public water system, with a static pressure of 84 psi (580 kPa).

There were no weekly inspection programs of the sprinkler control valves and no cutting or welding permit system.

An outside contractor was hired to enlarge a fire door between storage areas. A spark from a cutting torch ignited the bales. The contractor’s employees unsuccessfully tried to extinguish the fire with nearby extinguishers. An employee of the building noticed the fire and called a supervisor, who promptly called the fire department. Automatic sprinklers were operating when the fire department arrived. Up to ten hose streams were in use at one time. Automatic sprinklers quickly stopped the spread of the fire.

Hose streams were used mainly to extinguish fires in the bales. There was no damage to the building except for skylights broken by the fire department to vent the smoke. About 475 bales of jute were partially burned or broken open. Fifty-eight bales were wet, but not broken, and 124 were undamaged. Salvage was reported to be good.

3.3.3 Finished Goods Heavily Damaged

Compressed bales of cotton were stored directly on the floor to a height of 14 ft (4 m) over 75% of the floor area of the warehouse. The remainder of the building was occupied for the storage of finished cotton surgical supplies in cartons on wood pallets to a height of 10 ft (3 m).

The warehouse was protected by an ordinary-hazard sprinkler system with 165° (74°C) temperature rated heads. Arrangement was side-end feed on a dry-pipe system. The building was heated by gas-fired unit heaters hung from steel roof joists.

A fork lift truck driver in a cross aisle noticed flames spreading rapidly across the top of the bale storage at the end of an aisle. There had been no indication of anything unusual in same aisle 5 to 10 minutes earlier. He drove to the center of the warehouse to report the fire. The dry-pipe valve tripped and sounded the main alarm at the main plant. The driver and two other employees returned to fight the fire with hand extinguishers but were quickly turned back by the heat. As they left the warehouse, the fire door closed automatically.

The plant fire chief arrived 15 minutes after the fire was first noticed and then summoned the public fire department. The plant fire brigade promptly laid two 1½ in. hose. The public fire department responded and used one pumper and two 1½ in. lines. Smoke was vented by breaking out windows at the eave line. Three large holes were also cut in the roof about two hours after the fire was first started. Approximately 30 sprinklers opened and succeeded in protecting the building. Hose streams were used for mop up.

No facilities for removal of sprinkler water had been provided. In fact, exterior doors were blocked by raised concrete loading ramps installed inside the building. Removal of cotton bales could not begin until a hole was broken through a wall to drain off about 2 ft (0.6 m) of water.

There were about 800 bales of cotton in the warehouse. Approximately 70% of the cotton was scorched or burnt. The finished stock was wet and unsalvageable. Damage to the building was limited to broken windows and some minor damage to the roof deck.

The apparent cause was ignition of lint and bale strands by a gas-fired heater. During the final stages of bale removal, it was noted that bale storage was within 2 ft (0.6 m) of an open flame type gas-fired unit heater along the north wall. This was the area in which the flame was first observed. Removal of gas-fired unit heaters from bale cotton storage area was recommended.

3.3.4 Hair Lost

The warehouse was occupied for storage of baled hair, tula fiber (vegetable fiber resembling sisal), and coir fiber (coconut fiber). Storage heights were up to 13 ft (4 m) and fibers were mixed. The building was protected by a dry-pipe system with an inoperative exhauster. A modern pipe size schedule was used.

Security personnel making his rounds late in the evening noticed smoke in the warehouse. He promptly called the fire department who arrived within minutes of their notice. The public fire department utilized several pumpers and a number of hose streams. The chief then requested that sprinklers be shut off to permit his men to attack the fire. The automatic sprinkler systems had limited the spread of the fire and were controlling the fire. Burning bales were then removed from the building and the fire extinguished about 4 hours after it was first detected.

Approximately 139 bales of hair and fiber were burned and wet to varying degrees. Smoke-damaged hair could not be salvaged as it was used for filling, for bedding, and furniture. Practically all of the wet fiber was salvaged. Damage to the building was limited to about 400 ft^2 (38 m^2) of the roof which was severely charred and required replacement.

The most likely cause was discarded smoking materials either by the plant personnel or itinerants. The fire department had responded to several fires in the neighborhood when itinerants had forced entry into several buildings for a night's lodging.

3.4 Fire Fighting

Baled fibers are all readily combustible, having generally similar burning characteristics, and require the same safeguards and fire fighting procedures.

Fire will flash rapidly over the surfaces of bales, although somewhat more slowly over flax and wool than over the other fibers. The flash is followed by slower flame travel at the surface, tenacious burrowing into the pile between bales, and, except in high-density bales, penetration of the interiors of individual bales.

Firefighting efforts are complicated by dense smoke given off by the burning fibers. The storage area must be vented. Firefighting personnel must wear self-contained unit breathing apparatus, ''Air Packs'', to permit early entry and effective use of hose streams. Air packs are preferred to smoke masks as the masks use a filter system which may become clogged with ash, fibers, etc.

Automatic sprinklers will prevent structural damage and, where piles are properly arranged and separated, will normally confine the fire to the initial pile. They may not prevent extensive burrowing of a shielded fire within a pile. Complete extinguishment usually requires removing smoldering bales outdoors where water can be applied sparingly without opening the bales.

Once outdoors the bales should be separated by at least 5 ft to prevent kindling and spreading. The smoldering fires should be extinguished by digging out the burning fibers with a hook or by using a probing nozzle and garden hose. Bale ties should not be broken. Broken bales may not be salvageable because of the difficulty in handling loose fibers. An unextinguished fire will quickly involve all the loose fibers.

At some baled-fiber fires the fire was thought to be extinguished or under good control. The sprinklers were shut off without first having charged hose lines at hand and without stationing someone to open the sprinkler valve. Then the fire blazed up again.

In one case, the reflash was of such intensity that fire fighters were driven from the building, and indoor sprinkler control valves could not again be opened, resulting in severe damage to building and contents and requiring 18 large hose streams for extinguishment.

3.5 Salvage

Baled fibers are subject to heavy fire and water damage. The salvage on partially burned bales is usually low. Water-soaked bales ferment and mildew with evolution of heat and loss of essential properties unless they are opened and dried quickly. The amount of loss will depend mainly on the amount of fiber in a storage section, size and height of piles, adequacy of aisles, adequacy of sprinkler protection, efficiency of fire-fighting efforts, and speed and effectiveness in handling and drying wet bales.

In properly arranged storage, fire is normally confined to the pile where it originated. However, salvage of burned bales in this pile will be low, usually less than 25%. Sprinklers will operate somewhat beyond the confines of the fire, in most cases wetting down the piles immediately adjacent to the burning pile. Opening and drying of a moderate number of wet bales before deterioration occurs is not a serious problem at most plants. The cost of handling and drying will range from 20 to 30% of the value of the wet fibers, and overall salvage will approximate 60 to 70% of value.

On the other hand, where piles are too large, too high, inadequately separated, or otherwise improperly arranged, damage will be correspondingly greater. The fire is likely to spread and be very difficult to break down and bring under control. Salvage in piles directly involved may range from zero to about 20%. Sprinklers may operate throughout the area, wetting down the entire storage. Overall salvage of wet bales may be 50% or less of value.

Table 3. Ignition Sources in Various Baled Fiber Storages

Commodity	*Ignition Source*	*% of Fires Involved*
Cotton	Sparks from bale ties	42
	Unknown, probably sparks from bale ties of fire-packed bales	26
	Defective lift trucks	14
	Miscellaneous: cutting and welding, electrical and mechanical faults, smoking and spontaneous ignition	18
Wool	Incendiarism	20
	Unknown	20
	Spontaneous ignition	10
	Cutting and welding	10
	Mechanical and electrical faults	20
	Miscellaneous	20
Hemp, Sisal, Jute, & Flax	Incendiarism	21
	Smoking	21
	Electrical faults	17
	Cutting and welding	17
	Miscellaneous	24
Synthetic fibers	Electrical faults	28
	Sparks from bale ties	17
	Spontaneous ignition	11
	Smoking	11
	Unknown	11
	Miscellaneous	22

In any arrangement, prompt starting of salvage operations increases the salvage dramatically.

4.0 REFERENCES

4.1 FM

Data Sheet 2-7, *Installation Rules for Sprinkler Systems Using Large-Drop Sprinklers.*

Data Sheet 2-8N, *Installation of Sprinkler Systems.*

Data Sheet 7-1, *Fire Protection for Textile Mills.*

Data Sheet 8-0, *General Storage Safeguards.*

Data Sheet 8-1, *Commodity Classification.*

Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities.*

4.2 NFPA Standards

NFPA 231, General Storage

NFPA 231C, Rack Storage of Materials

NFPA 231E, Baled Cotton Storage

APPENDIX A GLOSSARY OF TERMS

Baled Fiber Storage: storage of fibers in large, compressed packages or bundles, wrapped in burlap or plastic film using metal or plastic ties.

APPENDIX B DOCUMENT REVISION HISTORY

April 2017. Interim Revison. Information about the use of cement-asbestos construction was removed from recommendation 2.1.3.

January 2000. This revision of the document has been reorganized to provide a consistent format.

May 1998. This data sheet was converted to electronic format.

This data sheet was issued originally in March 1974, superceding information contained on pages 69-18 and 69-22 through 69-25 of the FM Global *Loss Prevention Handbook.*