STORAGE OF WOOD CHIPS

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1.0 SCOPE

This data sheet covers the hazards associated with the storage of wood chips, sawdust and other wood waste material. It also includes loss experience and recommendations for minimizing losses.

Most pulp and paper mills throughout the world receive all or part of their wood supply as chips which are stored outdoors. Wood chips frequently are obtained from wood waste at sawmills and woodworking plants. Many mills also chip the logs when received in order to economize by storing and handling the raw stock in chip form. Chips stored outside deteriorate much less rapidly than logs, and handling is simplified. Many pulp and paper mills also store low-grade wood chips, commonly referred to as hog fuel, which are used to fuel their steam boilers. Some power plants also have converted to, or built, wood chip-firing boilers as an alternative energy source to oil or gas.

Environmental and energy concerns have resulted in the storage of wood chips indoors, particularly at particleboard or similar manufacturing plants. In addition, wood chips are frequently stored in silos, bins or sheds prior to and during processing into the end product.

1.1 Changes

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

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Occupancy

2.1.1 General

2.1.1.1 Quality control of wood chip storage should be exercised through one or more of the following measures:

1. Purchase wood chips of specified quality to minimize the presence of fines and contaminated or dirty chips.

2. For on-site chipping, use wood chip machines of suitable capacity to help ensure production of wood chips of proper quality and size.

3. Use wood stock that is free from bark and decay.

4. Control the rate of pile buildup.

5. Preferably handle wood chips on a “first in—first out” basis.

2.1.1.2 Outdoor sites for wood chip storage should be level and either graded with clean soil or preferably paved.

2.1.1.3 Keep storage sites free of combustibles such as grass, brush and rubbish.

2.1.1.4 Prohibit smoking near or within wood chip storage sites.

2.1.1.5 Buildup and reclaiming of good quality wood chip storage piles should be based on a maximum turnover time of one year. Buildup and reclaiming of wood chip storage piles containing appreciable quantities of sawdust or other wood waste material should be based on a maximum turnover period of three months.

2.1.1.6 If wood chip storage piles become exceptionally dry from prolonged hot, dry weather, periodically wet down the surface of the piles to minimize the possibility of a surface fire.

2.1.2 Wood Chip Storage Pile Arrangement

2.1.2.1 Limit outdoor storage piles of good quality wood chips to 50 ft (15 m) in height, 300 ft (91 m) in width and 800 ft (244 m) in length, with no pile exceeding 50,000 units capacity. Long narrow piles facilitate manual fire fighting if necessary. Limit sawdust or other wood waste piles to 25 ft (7.5 m) in height.

2.1.2.2 Provide at least 50 ft (15 m) separation between outdoor wood chip storage piles and any important plant buildings.

2.1.2.3 Provide at least 50 ft (15 m) separation between outdoor wood chip storage piles of 15,000 units or larger for fire fighting access and interexposure control.

2.2 Equipment and Processes

2.2.1 Follow the guidelines in Data Sheet 7-40/13-27, *Heavy Duty Mobile Equipment*, under "Smaller, More Mobile Equipment" for mobile wood chip moving equipment.

2.2.2 Refuel mobile internal combustion engine-driven wood chip moving equipment at a safe location, at least 50 ft (15 m) from any wood chip storage site.

2.2.3 Provide magnetic separators on conveying or transfer equipment for wood chip storage. Loss experience has shown tramp metal in wood chips to be a factor in spontaneous heating incidents.

2.2.4 Fireproof (2-hour fire resistance rating) steel support legs of wood chip stackers and reclaimers if they are within the wood chip storage piles. Loss experience indicates that unprotected legs may cause or accelerate spontaneous heating; in addition, they are susceptible to heat damage.

2.2.5 Conveyor and motor enclosures should be of noncombustible construction.

2.3 Protection

2.3.1 Install yard mains and hydrants capable of delivering the recommended water flow at pressure adequate for the longest hose lines expected to be used. Provide sufficient 2-½ and 1-½ in. (63 and 38 mm) fire hose, and an adequate supply of large and small combination spray-solid stream nozzles, to fight fire at any part of the chip yard.

Surface fires can be extinguished by close-range use of spray nozzles. Solid streams can disperse water over the surface at considerable distance, depending on nozzle size and pressure. Solid streams also can be used to wet down exposed structures and buildings. Spray nozzles and 1-½ in. (38 mm) hose can be effectively used on small burning areas.

2.3.2 When hot spots or areas are detected within outdoor wood chip storage piles, provide water spray or fog coverage while uncovering the pile, or flood the affected area with water through perforated piping prior to digging out the pile. Mobile equipment may be used to dig out and isolate heated areas within wood chip storage piles.

2.3.3 Water supplies should be at least 1000 gpm (3800 dm^3/min) at 80 psi (552 kPa, 5.5 bar) residual for single or multiple piles up to 15,000 units each. For single or multiple piles up to 50,000 units each, water supplies should be at least 2000 gpm (7600 dm^3/min) at 80 psi (552 kPa, 5.5 bar) residual. Water supplies should be available for a minimum of six hours.

2.3.4 Provide automatic sprinklers for all tunnels or other construction beneath wood chip storage piles and for any belt conveyor systems within the overall plant facility. Follow the protection guidelines outlined in Data Sheet 7-11, *Conveyors*.

2.3.5 Design storage silos, bins, sheds or other enclosures where dried wood chips are handled or where dry wood dust can accumulate in accordance with Data Sheet 7-76, *Prevention and Mitigation of Combustible Dust Explosions and Fires*. Horizontal structural members on interior surfaces should be covered to minimize the accumulation of wood dust.

2.3.6 Provide automatic sprinkler protection for wood chip storage silos, bins and sheds or other enclosures with capacities of 250 units or more in accordance with Table 1. Do not attempt to extinguish wood chip fires within silos or other enclosures by smothering (i.e., excluding air) as flammable gases may accumulate and possibly create an explosion hazard.

Table 1. Sprinkler Protection Requirements for Wood Chip Silos, Bins, and Sheds or Other Enclosures

Type of Sprinkler System	*Sprinkler Temperature Rating °F (°C)*	*Density gpm/ft² (mm/min)*	*Area of Demand, ft² (m²)*
Wet	212-286 (100-141)	0.20 (8)	3000 (278.7)
Wet	160 (71)	0.20 (8)	4000 (371.6)
Dry	212-286 (100-141)	0.20 (8)	4000 (371.6)
Dry	160 (71)	0.20 (8)	5000 (464.7)

2.3.7 Provide a reliable means for prompt transmission of fire alarms at a readily accessible location near any outdoor wood chip storage area.

2.3.8 Provide recorded watch service of any outdoor wood chip storage area when unattended by regular operators.

2.3.9 Protect large outdoor wood chip stackers and reclaimers operating on rails against wind damage in accordance with Data Sheet 1-62/17-16, *Cranes.*

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Chip Handling and Storage

3.1.1 Outdoor Storage

Chips are frequently delivered to pulp and paper mills in special bottom-dump cars or trucks to receiving stations consisting of one or more track pits. Where woodworking plants are nearby, chips may be transported directly to the receiving station or to the digester building by pneumatic conveyor. Chip piles are frequently formed by pneumatic or belt conveyors. The exposed steel support legs are usually surrounded by the chips.

Chips are measured in ‘‘units,’’ one unit being equal to 200 ft^3 (5.7 m^3) of compacted chips and roughly equivalent to one cord of ranked pulpwood.

The amount of storage depends on production requirements and the available supply. A two months’ supply appears to be average. However, supplies may vary from upwards of six months to much less than two months if there is a reliable source of chips nearby. Chips are frequently stored in one large pile for purposes of economy in conveying equipment and handling; however, many plants may store chips in smaller piles of different wood species for different end products (e.g., newspaper, cartons and kraft paper).

The volume of single large piles may range from 15,000 to 100,000 or more units. Pile heights of 35 ft (10.7 m) are common but have reached upwards of 160 ft (48.8 m). Multiple piles frequently range from 3,000 to 15,000 units each.

For removal, chips are usually pushed by bulldozers or withdrawn by screw conveyors into recovery pits, which are frequently located beneath the piles. From there they are carried by pneumatic or belt conveyors to the mill. Trucks or power scoops also may be used to move chips directly to recovery pits. Trucks, jeeps and bulldozers can readily negotiate piles with steep slopes of 30° or more. The chips become compacted by their own weight as well as by the traffic over the surface. Although freely dropped chips may take a 45° repose angle, steeper, almost vertical slopes may be formed on the recovery side of the pile.

A recent development in the storage and removal of wood chips is the use of automatic stacking and reclaiming systems that operate on rails (Fig. 1). In these systems chips are stored by stackers, which are essentially belt conveyors, and removed by reclaimers, which operate on top of the storage piles.

3.1.2 In-Process Storage

Wood chips frequently are transferred by pneumatic, belt or screw conveyor from outside piles for temporary storage in silos, bins, or sheds prior to or during processing.

Silos may be as large as 50 ft (15.2 m) in diameter and 100 ft (30.5 m) high. Silos may be constructed of steel with ceramic tile facing, steel shell with some type of protective exterior coating, poured-in-place concrete, precast concrete staves with steel hoop reinforcement, or occasionally wood. Silos are usually cylindrical with cone-shaped bottoms.

Bins are generally made of steel plate, ceramic tile, or poured reinforced concrete. Many older bins are of wood construction. Bins normally are rectangular with hopper-shaped bottoms.

Sheds normally are steel-on-steel frame construction or wood construction.

3.1.3 Indoor Storage

Particleboard and similar manufacturing plants often store wood chips or waste wood in large buildings adjacent to or within the preparation area. Chips usually are transferred to the storage building by pneumatic or other type conveyor and removed by front-end loaders. Buildings frequently are of wood construction and chips are stored to heights of 50 ft (15.2 m) in many cases.

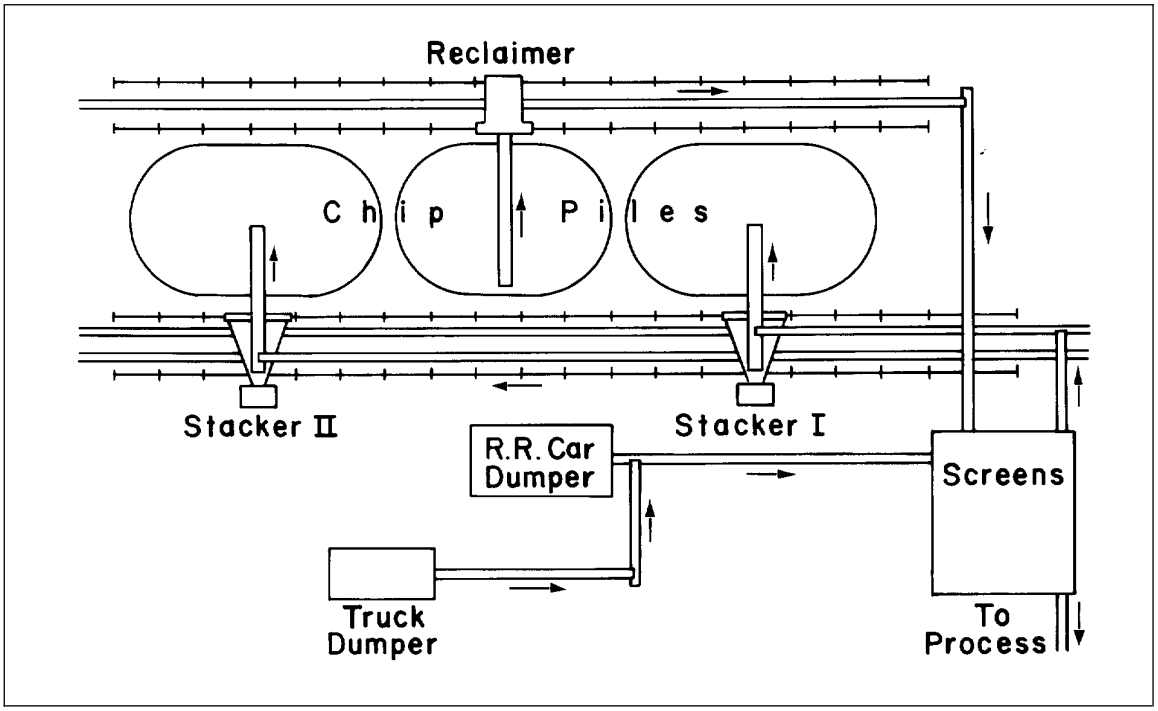

Fig. 1. Automatic wood chip handling system.

3.2 Hazards

3.2.1 Outdoor Wood Chip Storage Piles

Two types of incidents occur in outdoor wood chip storage piles: surface fires and internal heating, which may result in subsequent fires. The latter is far more prevalent.

Surface fires occur infrequently due to the normally high moisture content of outdoor wood chip storage piles. Tests have shown that wood chips with 50% or greater moisture content (by weight) are too wet for easy surface ignition. However, surface chips may have low moisture content as a result of prolonged dry weather conditions. Surface fires occasionally occur from external exposure fires. Surface fires also originate from mobile equipment working on wood chip storage piles. Under dry weather conditions, a surface fire, once initiated, could spread rapidly and radiate considerable heat, especially if exposed to winds over 20 mph (9 m/s). Tests and limited fire experience also indicate slow penetration of a surface fire into a pile.

Twelve incidents involving internal heating of wood chip storage piles have been reported to FM in the last ten years. All were attributed to spontaneous heating and *subsequent ignition* when the chips were exposed to sufficient air. The subsequent fires frequently occur while attempting to separate the ‘‘good’’ chips from the heated chips after discovering spontaneous heating within the storage pile. Wood chips are normally subject to decay, and spontaneous heating can occur if the heat generated successively by normal respiration, bacterial activity and oxidation is not readily dissipated.

Immediately after storage, wood chip piles begin to heat due to cell breathing, biological activity (microbial oxidation). Wood chip piles can reach a maximum temperature of approximately 150°F (66°C) after two weeks; however, temperatures within the wood chip piles occasionally continue to climb and spontaneous heating results. Factors cited in such spontaneous heating losses include pile height or a low surface-area-to-volume ratio, age of wood chips—older and more compacted from mobile handling equipment traffic, low air flow, and the presence of metal or other impurities including bark, decayed wood and sawdust. Pneumatically conveyed or blown wood chips are more susceptible to spontaneous heating due to separation and stratification of fines which can hamper heat dissipation from the storage pile. Steel conveyor legs within wood chip storage piles may have either caused or accelerated the spontaneous heating process.

During the spontaneous heating process, wood chips lose fiber content and char. The charred chips also may contaminate the good chips within the pile, minimizing their pulping value. This damage may occur over

a long period of time at elevated temperatures before smoke is evident. This damage normally occurs at temperatures that are lower than the temperatures where glowing combustion is observed.

3.2.2 In-Process and Indoor Storage

Spontaneous heating also can occur in contained or confined wood chip storage. However, most fires involving such storage have resulted from improper cutting and welding procedures or malfunctioning wood chip handling equipment, particularly conveyor systems.

In addition to the spontaneous heating and fire hazard, contained or confined wood chip storage also may have a dust explosion hazard. That is, if dried wood chips are stored or dry wood dust can accumulate on horizontal structural members within silos, bins, sheds or other enclosures, a dust explosion hazard may exist. Where moist or green wood chips are stored, the dust explosion hazard is significantly reduced.

4.0 REFERENCES

4.1 FM

Data Sheet 1-62/17-16, *Cranes*.

Data Sheet 7-11, *Conveyors*.

Data Sheet 7-40/13-27, *Heavy Duty Mobile Equipment*.

Data Sheet 7-76, *Prevention and Mitigation of Combustible Dust Explosions and Fires*.

4.2 NFPA Standards

NFPA 46, *Storage of Forest Products*, 1996.

APPENDIX A GLOSSARY OF TERMS

This document does not have any defined terms.

APPENDIX B DOCUMENT REVISION HISTORY

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

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