



Property Risk Consulting Guidelines

A Publication of AXA XL Risk Consulting

PRC.17.23.1.1

BAKERIES

INTRODUCTION

Bakery products include bread, pastry, cakes and cookies. Although doughnuts are fried, they are also considered bakery products. The number and location of bakeries depends on the shelf life of the products baked. Since bread must be made and delivered daily, bread bakeries are the most numerous and are located centrally within their daily delivery area.

Pastry, cakes, and doughnuts have longer shelf lives. Bakeries making these items tend to be larger and less numerous than bread bakeries, and they are regionally located. Cookies have the longest shelf life and are baked in the largest bakeries. These bakeries may be located anywhere, since the product shelf life is long enough to ship it wherever needed. Some bakeries make a combination of products, usually for local delivery.

Although crackers, pretzels and some potato chips are baked, these are classified as snack foods. PRC.17.23.1.6 covers the manufacturing of these foods.

The primary hazards of bakeries are those associated with combustible dusts, such as flour and corn starch, oils used in the recipes and for lubrication, baking ovens which are usually fuel fired; and refrigeration equipment. Like any food processing facility, bakeries are highly susceptible to contamination. This PRC Guideline discusses the processes and hazards associated with bakeries and how to arrange and protect them.

PROCESSES AND HAZARDS

The basic process in any bakery is to combine ingredients in the proper ratios and bake the batter in heated enclosures at the correct temperature for a specified amount of time. Small bakeries may use batch processes similar to home baking, but most bakeries use large, continuous, automated processes.

Raw Materials

Raw materials for bakeries include liquids and solids, the latter of which are usually finely ground or powdered. Common liquid raw materials are water, vegetable oil, margarine, butter, corn syrup, molasses and flavor extracts. Some of the liquid raw materials are fire hazards. Vegetable oils, margarine and butter are combustible, and many flavoring extracts are alcohol-based. When liquid raw materials are stored in tanks, they also have the potential to cause liquids damage from spilling or leaks. Some liquids, such as molasses, must be heated so they flow properly. The heating system introduces the hazards of high-current electrical systems, pressurized steam piping or fuel fired equipment.

Some raw materials, such as milk and egg products, must be kept refrigerated. Refrigeration introduces the hazards of combustible insulation materials, compressed gases, potential vapor release, moving mechanical parts and electrical components. Loss of refrigeration equipment usually results in having authorities declare the materials spoiled.

Common solid raw materials are flour, sugar, yeast, cornstarch, chocolate, powdered milk and spices. Depending on how fast these materials are used, they may be stored in bags, bins or silos. The silos are usually filled from large pneumatic conveying systems. Most of these finely ground and powdered materials have the potential to explode if dispersed in the air. Other solid raw materials used in bakeries include dried or candied fruit, nuts, chocolate chips and other similar ingredients. While these materials may not always present hazards of their own, they can be easily contaminated.

Batter Mixing

Raw materials must first be weighed or measured. In some cases, the solid materials are weighed or measured manually, from bags or portable bins. This requires dust collection systems designed for the open handling of these materials. Most newer facilities use computer controlled systems to transport solid materials through closed piping by means of pneumatic or screw conveyors and to weigh these materials in closed hoppers. While this reduces the dust hazard, it makes the process susceptible to problems from computer failure. Liquids can be manually or automatically metered.

After the liquid and solid raw materials have been measured, they are placed in a mixing vat. A mechanical agitator then blends the ingredients into a batter. The motors and gearboxes operating the mixer agitators are subject to mechanical or electrical breakdown.

In the case of bread baking, temperature and humidity control is essential to proper blending and rising of the batter.

Baking

In bread bakeries, steam heated enclosures called proof boxes are used for getting the bread to rise before it is sent to the ovens. In most other bakeries, the batter goes directly to the ovens.

Most bakery ovens are continuous conveyor-fed ovens that operate around 300°F (150°C). Bakery oven construction allows for complete disassembly or easy access for cleaning. Most bakery ovens are directly gas-fired, though electric ovens are common for products requiring precise temperature control. Many bakeries have custom made ovens.

The conveyors in bread, pastry and cake ovens usually consist of metal pans bolted to a conveyor chain. Conveyors in cookie ovens are usually continuous sheets of stainless steel. To keep the batter from sticking, the pan or sheet is first greased with vegetable oil. Soy, cottonseed and canola oils are preferred because their cholesterol content is lower than other vegetable oils. Safflower and corn oil are also used. Coconut and palm oils have become less common, as has animal fat. Where used, animal fat is either circulated in a centrally heated closed loop system or immersion heated in an open drum near each oven.

After greasing, batter is added to the pan or sheet. Numerous methods are used to dispense the right amount of batter from the mixer onto the conveyor. The batter is then conveyed through the baking oven.

At the oven exit, the baked product is transferred to another conveyor that takes it through a cooling process and on to the packaging area. After the baking pan is emptied, it is sprayed with fresh oil to float crumbs into a catch basin. The pan then turns over and is ready to enter the process again.

Older pan greasing methods deluge the pan with oil, causing excessive oil buildup on the pan and conveyor and in the oven and ductwork. Newer methods use precision nozzles that apply the minimum amount of oil needed.

Fires in bakery ovens are common. They can be caused by inadequate cleaning, faulty oven controls, conveyor slowdown, or incorrect dispensing of batter. The baked product then overheats and starts burning. Fire can then spread through the oil buildup on conveyors and inside ovens and ducts. Such fires often damage baking pans and conveyor linkages.

Although not as common as fires, explosions are possible in bakery ovens. This can happen if unburned fuel accumulates in the firebox and is subsequently ignited.

Bakery products may be cooled while traveling on long conveyors, or in forced cooling tunnels. When cooling tunnels are used, refrigeration equipment and the fans and fan motors providing cooling air are essential to their proper operation. Cooling tunnels may also contain combustible conveyor belts, and older cooling tunnels are often made of wood.

Doughnut Making

Doughnuts are made in deep fat fryers, which are long tanks filled with hot cooking oil. The tanks are heated by indirect gas firing or external electric heaters. Exhaust hoods and ductwork remove hot oil vapors from over the tank and drain areas. The doughnut batter moves continuously through the fryer on a chain conveyor.

Packaging

Most bread is automatically sliced and bagged in preformed polyethylene bags, which are closed with wire-reinforced plastic ties. Some bread is packaged in open paper bags. Plastic tote trays are generally used to transport the packaged bread to delivery trucks.

Pastries are frosted and placed on plastic-coated cardboard. Larger pastries and doughnuts are then placed in boxes, which often contain cellophane windows. Smaller pastries are “fin packaged” (slipped into a cylindrical packaging tube then sealed at both ends). One automated pastry packaging process takes preprinted polyethylene from a roll, cuts it to size and seals it around the pastry with a water-based adhesive. Pastries are sometimes frozen right after packaging.

Cakes are packaged much like pastries. Cookies are either put in plastic trays and fin packaged or put in bags.

The various materials used for packaging baked products can add substantial combustible loading to the bakery.

Finished Goods

Some bakeries have refrigerated warehouses for storing finished products until time for shipping. Although temperatures are low in these warehouses, fire is still possible. Even a small fire is likely to render all products in the warehouse a total loss. Because of the short shelf life, bread bakeries usually do not have extensive finished goods storage. The finished bread is generally placed in plastic trays and staged near the shipping docks until sent out on the delivery trucks.

Vehicle Repair

Many larger bakeries operate their own fleets of delivery trucks. Often, these facilities will include a vehicle repair area for maintaining these delivery trucks. The vehicle repair areas generally contain significant quantities of flammable and combustible liquids, and frequently conduct hot work operations as part of the repair process.

LOSS PREVENTION AND CONTROL

Since very small amounts of combustion products can be judged to damage 100% of bakery items in a fire area, preventing fires is of primary importance. To keep fire from spreading to other areas, well designed protective systems are also needed.

Management Programs

Implement management programs covering all the areas discussed in *OVERVIEW*, AXA XL Risk Consulting’s total management program for loss prevention and control. Tailor these programs to the baking process, paying particular attention to the following areas:

Hazard Evaluation

Evaluate the hazards of all parts of the facility, including raw materials storage, batter preparation, the baking process, product packaging, finished product storage, and delivery vehicle maintenance shops. Take into consideration the possible extent of contamination from incidents starting in each of these areas. Design and protect the facility to minimize the overall exposure to contamination.

Evaluate the importance of heating and refrigeration systems. Install duplicate systems, design systems with extra capacity, or keep spare components for these systems so that loss of one system will not spoil a large amount of product.

Re-evaluate hazards when considering any process changes. Include such changes as increasing baking temperature or time, baking a new type of product, modifying the ventilation system, or using a different lubricating oil. Also re-evaluate hazards when changing the storage configuration or the quantity of any raw material or finished product.

Hazardous Materials

Analyze the hazards of all materials used in the facility. Classify gases and liquids and the areas containing them in accordance with NFPA 497. Classify ground and powdered solid materials and the areas containing them in accordance with NFPA 499. Also analyze the hazards of solid materials that can melt and burn, such as butter and margarine.

Hot Work

All cutting, welding and other hot work operations should be carefully managed. A hot work permit system should be used to document the required procedures and precautions. Maintenance shops and vehicle repair areas should receive particular attention with regard to hot work management due to the frequency of hot work jobs, and the presence of flammable and combustible liquids, etc.

Housekeeping

Frequently clean residue of fats, oils and greases from conveyors and collector trays, and from the insides of ovens, hoods and ducts. Base the cleaning schedule on the rate of residue accumulation. A typical schedule should include a daily steam cleaning, weekly scrubdown and monthly chemical cleaning. Arrange the process so that under normal operating conditions, as little residue as possible is deposited.

Areas where combustible powders are handled should be inspected for dust accumulations on a daily basis, and cleaned as necessary. Sweep or vacuum any accumulated dust. Do not “blow down” combustible dust from building members, as this will suspend the dust in the air, possibly creating an explosive concentration.

Maintenance

Implement preventive maintenance for the following equipment:

- Fuel fired ovens, in accordance with NFPA 86, and PRC.4.0.1.
- Boilers providing steam for proof boxes or other process heating needs, in accordance with NFPA 85, PRC.4.0.1 and PRC.7.1.0.5, as applicable.
- Conveyors, in accordance with PRC.9.3.1.
- Ordinary motors and electrical equipment, in accordance with PRC.1.3.1.
- Hazardous location electrical equipment, in accordance with NFPA 70B.

Also implement preventive maintenance programs for all weighing, measuring and refrigeration equipment.

Pre-Emergency Planning

Plans should be developed for handling fires in the high hazard areas such as baking ovens and doughnut fryers. Form contingency plans for making up production in the event of adverse circumstances. Take into account 3-shift operations, custom equipment that cannot handle other

products, equipment that is hard to replace, and refrigeration equipment. When possible, make arrangements for outside assistance. Keep contingency plans up to date.

Smoking Regulations

Develop and strictly enforce smoking regulations prohibiting smoking in all areas containing food or packaging materials. Be particularly watchful of storage areas.

Construction

Use noncombustible construction materials for buildings, insulation and interior finishes. Stainless steel is preferred for surfaces with cleanability requirements. Where plastic materials must be used, select materials that have flame spread and smoke contributed ratings of 25 or less.

Cut off warehouses and vehicle maintenance shops with fire walls having a 3 hour fire resistance rating. Provide 3 hour rated fire doors at wall openings. Protect conveyor openings in accordance with PRC.2.2.2.

Building Protection

Provide sprinkler protection throughout the facility. Design the sprinkler systems in accordance with Table 1.

TABLE 1
Sprinkler Design For Bakeries

Area	Sprinkler Design Guidance
Storage areas	NFPA 13 and PRC.12.1.1.0
Areas with flammable or combustible liquids	NFPA 30 and PRC.8.1.0
All other areas	NFPA 13, Ordinary Hazard, Group 2 and PRC.12.1.1.0.

Raw Materials

Arrange bin filling systems for powdered raw materials in accordance with NFPA 61. Install and protect pneumatic conveying systems for powdered raw materials in accordance with NFPA 654. Install the exhaust for conveying systems in accordance with NFPA 654.

Protect silos against accumulation of static electricity in accordance with NFPA 77. Equip bins and silos with venting for deflagrations in accordance with NFPA 68, or install explosion suppression systems in accordance with NFPA 69 and PRC.13.5.1. Larger silos may also have dust collectors over the atmospheric vents, to prevent dust from escaping during filling operations. These dust collectors should also be provided with deflagration venting.

Provide dust collection pickups at points where powder can escape. Protect dust collectors in accordance with NFPA 68, or in accordance with NFPA 69 and PRC.13.5.1.

Arrange systems storing and dispensing flammable or combustible liquids in accordance with NFPA 30 and PRC.8.1.0.

Install electrical equipment appropriate for the hazard where it is installed. Use equipment listed for Class II, Group G in areas handling powders. Use electrical equipment listed for Class I, Groups C and D, or equivalent, in areas handling flammable liquids or liquids heated above their flash points. See PRC.5.12.0.1 for equivalent classifications.

Batter Mixing

Control dust accumulations where dry materials are loaded into mixers. Provide dust collection hoods if needed, and implement daily housekeeping procedures.

Arrange and protect computers controlling the weighing and mixing processes in accordance with PRC.17.10.1.

Baking

Provide combustion safeguards for boilers in accordance with NFPA 85 and PRC.4.0.1. Provide combustion safeguards for fuel fired baking ovens in accordance with NFPA 86 and PRC.4.0.1.

Interlock the power supply on electric ovens to shut down on high oven temperature. Interlock all ovens to shut down the heat source and batter flow if the conveyor stops.

Emphasis should be placed on housekeeping inside the baking ovens, including proper cleaning frequencies and procedures. Crumbs or product that fall from the conveyors, combined with any buildup of cooking oil residue, etc. can lead to significant oven fires.

Protect the inside of baking ovens and exhaust ducts with automatic total flooding CO₂ systems. Design and install these systems in accordance with NFPA 12 and PRC.13.3.1. In facilities with a continuous steam supply, manual steam flooding may be acceptable. Also protect oil heaters and reservoirs with automatic CO₂ systems.

As an alternative, automatic sprinkler protection can be installed inside the baking oven and exhaust stacks. Design the sprinkler system in ovens less than 8 ft (2.4 m) wide to provide 15 psi (1 bar) with all sprinklers operating inside the oven. Install the sprinklers with a maximum spacing of 12 ft (3.7 m). Design the sprinkler system in ovens 8 ft (2.4 m) wide and wider for an Extra Hazard Group 1 occupancy for those ovens containing flammable and combustible vapors and for an Ordinary Hazard Group 2 occupancy for those ovens only containing combustible product.

Protect the inside of wood cooling tunnels with automatic sprinklers. Design the system in accordance with NFPA 214.

Extensive conveyor systems are often used for cooling and transporting baked goods. Provide automatic sprinklers beneath the conveyors, where ceiling sprinklers are obstructed.

Doughnut Making

Protect the fryer, exhaust hoods and ductwork in accordance with NFPA 96 and PRC.9.2.7. Stop the heat source, conveyor, and batter flow upon actuation of the protection system.

Packaging

Keep the amount of packaging materials in the production area to a minimum. Store the bulk of packaging materials in an area cut off by 3 hour rated fire walls and doors.

Protect storage of all packaging materials in accordance with NFPA 13 and PRC.12.1.1.0.

Finished Goods

Protect high piled storage of finished goods in accordance with NFPA 13 and PRC.12.1.1.0. Protect frozen product warehouses in accordance with PRC.10.2.11.

Refrigeration Systems

Arrange refrigeration systems in accordance with ANSI/ASHRAE 15. Design and install ammonia refrigeration systems in accordance with ANSI/IIAR 2. For more information on protecting these systems, see PRC.7.2.1 and the NFPA *Fire Protection Handbook*.