



WSHCOUNCIL

Case Studies

Food Manufacturing



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Recall: 5M Model



Mission

relates to the work being carried out, including the objective(s) of the work and other aspects like work planning, preparation, operations and contingency.

Man

refers to the specific worker directly involved in executing the work, taking into account his or her reliability (attitude, discipline, physical health condition and psychological factors) and proficiency (knowledge, judgement and hands-on skills).

Management

refers to all who can influence the work being carried out. Management includes the supervision, control and scheduling of day-to-day operations. It also concerns the provision of training and the management of workplace risk.

Machine

refers to the equipment and/ or tools used for the work activity and their reliability (failure rate, accuracy and dependability) and capability (suitability for the task, degree of automation, and ability to cater to the needs of the human operator).

Medium

refers to the physical environment at the location of work. It includes weather conditions, visibility, nature of the terrain, indoor ambient conditions (e.g., temperature and noise level) as well as the extent of real-time on-site supervision.

Case 1

Worker Found Dead Inside Mixing Tank



DESCRIPTION OF INCIDENT

A worker was tasked to operate a blending machine at a food manufacturing company that produces powdered beverages and seasoning powder.

A co-worker found him inside a mixing tank with his body severely injured.

Investigation revealed that the worker could have fell in the mixing tank when he opened the cover of the tank to collect a sample of the blended product.

The worker was pronounced dead at the scene.

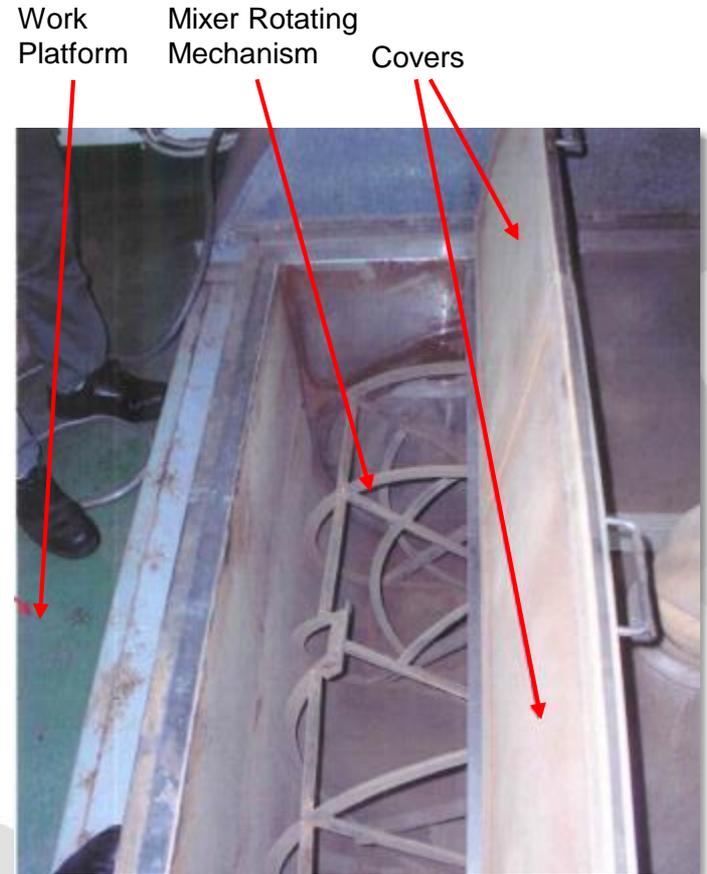


Figure 1: The mixing tank where the worker was found.

Case 1

Worker Found Dead Inside Mixing Tank



POSSIBLE CAUSES & CONTRIBUTING FACTORS

MISSION

- The worker was trying to collect a sample of the blended product from an unsafe location for quality analysis.

MACHINE

- The mixer of the blending unit was still in operation when the cover of the mixing tank was opened.

MAN

- Sample of the blended product was collected directly from the mixing tank when the blending unit was still in operation.

- The worker collected the sample directly from the mixing tank. Fellow workers should have intervened upon observing this wrong practice.

MANAGEMENT

- The hazard of direct sampling from the mixing tank was not identified.
- Sampling procedure (including location for sampling) was not clear to the workers.
- Poor management of change. Direct sampling was a common practice at the company's old premise. This practice was no longer applied at the company's new premises but yet it was still being carried out.

Case 1

Worker Found Dead Inside Mixing Tank



CAUSAL ANALYSIS

Evaluation of loss	<ul style="list-style-type: none">• One fatality
Type of contact	<ul style="list-style-type: none">• Caught between moving parts
Immediate cause(s)	<ul style="list-style-type: none">• Sample was collected from an unsafe location• Loss of balance whilst collecting the sample
Basic cause(s)	<ul style="list-style-type: none">• Failure to identify WSH risk related to the process• No safe work procedure for the work activity• No safety interlock on mixing tank cover
Failure of WSH Management System	<ul style="list-style-type: none">• No formal WSH management system implemented by the company

Case 1

Worker Found Dead Inside Mixing Tank



RECOMMENDATIONS & LEARNING POINTS

1. Carry out a risk assessment (RA) for the sample collection work activity (e.g., by conducting a job safety analysis).
2. Establish and implement a documented safe work procedure (SWP) for sample collection, e.g.,:
 - Collect the sample from the mixing tank only if the mixer rotating mechanism has been de-energised and come to a standstill; and
 - Collect the sample from an alternate safe location (from the blended product storage container) instead of directly from the mixing tank.
3. Install a safety interlock to make sure that the electrical power to the mixer rotating mechanism is cut off the moment the cover of the mixing tank is opened.
4. Put up a warning sign “*Moving parts. Do not open during operation.*” on the cover of the mixing tank.

Case 1

Worker Found Dead Inside Mixing Tank



RECOMMENDATIONS & LEARNING POINTS

5. Manage the change for work at the new premises and communicate the results of the RA to all workers. Make sure every worker understands the risks associated with the task (at the new location) and the control measures to mitigate the risks.
6. Train (e.g. initial training and refresher training) workers on the SWP for sample collection and provide necessary supervision for those who are new to the task.

Case 2

Worker Killed during Machine Cleaning



DESCRIPTION OF INCIDENT

A worker was assigned to clean a mixer at a food manufacturing company that produces noodles and vermicelli.

The worker's hand was suddenly pulled into the rotating blades of the mixer while he was cleaning the wall of the mixer. The mixer was still running when he was cleaning the mixer.

His co-workers quickly switched off the power, but it was too late as the worker was already caught in the blades of the mixer.

The mixer had to be cut open to extricate the body. The worker was pronounced dead at the scene.

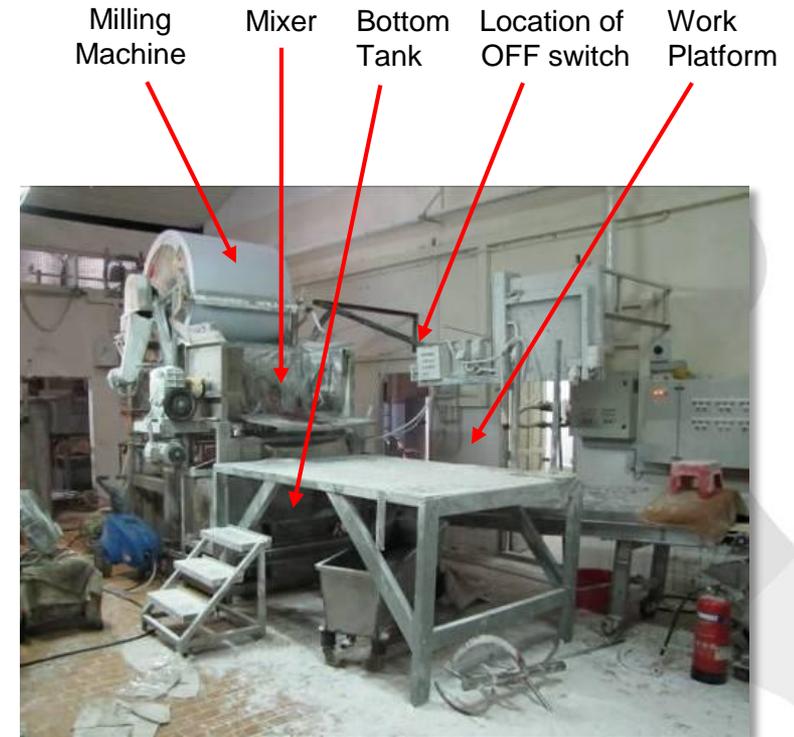


Figure 2: The mixing machine which the worker was dragged into.

Case 2

Worker Killed during Machine Cleaning



POSSIBLE CAUSES & CONTRIBUTING FACTORS

MISSION

- The worker was assigned to manually clean the mixer at the end of each work day.

MACHINE

- There was no machine guard to protect workers from the rotating blades of the mixer.
- The mixer "OFF" switch was situated far from the work location.

MEDIUM

- Both the machine and work area were covered in flour dust.

MAN

- The worker carried out the cleaning when the mixer was still in operation.
- The worker used a hand-held tool to scrape the mixture that was stuck to the mixer wall. It was likely that the tool (a scraper) used was short, hence the worker had to reach in deeper into the mixer.

MANAGEMENT

- Risk assessment did not cover cleaning of machines.
- There was no safe work procedure for the work activity. There was also no operation manual for the machine.
- Training was on-the-job and by word-of-mouth.

Case 2

Worker Killed during Machine Cleaning



CAUSAL ANALYSIS

Evaluation of loss	<ul style="list-style-type: none">• One fatality
Type of contact	<ul style="list-style-type: none">• Caught between moving parts
Immediate cause(s)	<ul style="list-style-type: none">• Mixer was not switched off before work commencement• Worker's hand pulled into mixer whilst cleaning
Basic cause(s)	<ul style="list-style-type: none">• No safe work procedure for the cleaning activity• No guarding and safety interlock on the mixer• No emergency stop button at work location• Appropriate cleaning tool not provided
Failure of WSH Management System	<ul style="list-style-type: none">• Cleaning of machine was not covered in risk assessment

Case 2

Worker Killed during Machine Cleaning



RECOMMENDATIONS & LEARNING POINTS

1. Check risk assessment (RA) to ensure that all work activities are covered (i.e., the cleaning work activity was missed out in this case).
2. Establish and implement a documented safe work procedure (SWP) for the cleaning work activity, e.g., lockout procedure for all maintenance and cleaning activities. This is to make sure that all energy sources are de-energised before starting work.
3. Install suitable guarding and safety interlock to make sure that the electrical power to the mixer is cut off once the guarding is removed.
4. Provide suitable cleaning tools (e.g., a long hand-held scraper) so that a safety distance between the mixer's blades and the worker's hands can be maintained at all times. To eliminate risks that may arise during manual cleaning, consider implementing automatic cleaning solutions where possible.

Case 2

Worker Killed during Machine Cleaning



RECOMMENDATIONS & LEARNING POINTS

5. Install an emergency stop button at the location of work and at multiple locations so any worker can immediately stop the mixer in the event of an emergency.
6. Provide formal training for workers on the SWP for machine cleaning. Set up training records so that a worker's training history will be documented and review the need for refresher training.
7. Carry out regular housekeeping to keep work areas free from dust. Dust poses a slipping hazard which can cause the worker to fall in the vicinity of the mixer.

Case 3

Worker Loses Finger when Working with Band Saw



DESCRIPTION OF INCIDENT

A worker was operating a band saw to cut frozen pork ribs when he sustained a deep cut on his right index finger.

While he was holding the frozen pork rib, he did not realise that his right hand index finger was hidden under the meat. His finger had come into the path of the saw blade and consequentially cut his finger.

The worker was immediately sent to the hospital where his right index finger had to be amputated due to the severity of the injury.

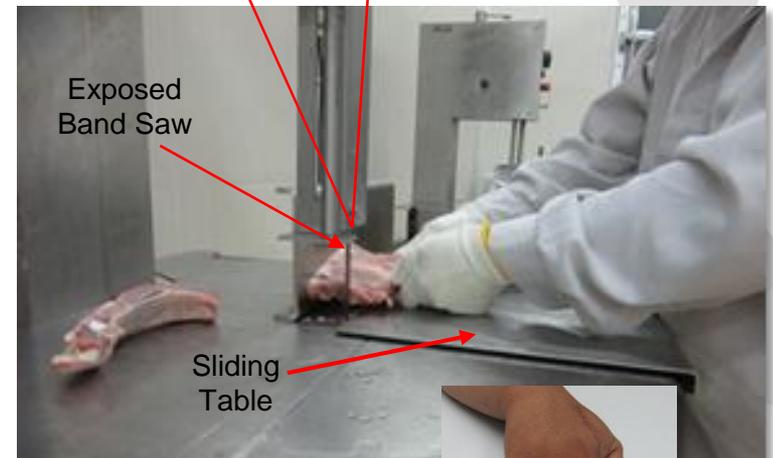


Figure 3a:
The worker was trying to cut the frozen pork rib to size when the injury occurred.



Figure 3b:
Photo of the worker's right hand after the amputation.

Case 3

Worker Loses Finger when Working with Band Saw



POSSIBLE CAUSES & CONTRIBUTING FACTORS

MISSION

- The worker was assigned to cut frozen meat into smaller pieces using a band saw machine.

MACHINE

- An adjustable guard for the saw blade was provided but was ineffective. With the said guard fully deployed, 10 cm of the cutting blade was still exposed.
- The sliding table and pusher were provided but were ineffective in pushing the large and irregular-shaped frozen meat into the band saw for cutting.

MEDIUM

- The frozen meat were large and irregular-shaped. The worker's fingers would have gone numb with cold after a few minutes of handling it.

MAN

- The worker used his hands to hold the large and irregular-shaped frozen meat for cutting as the sliding table or pusher were not suitable for use.

MANAGEMENT

- There was a lack of risk controls to eliminate or minimise exposure to the cutting blade. In particular, there was no safe work method or engineering control measure for handling large or irregular-shaped frozen meat.

Case 3

Worker Loses Finger when Working with Band Saw



CAUSAL ANALYSIS

Evaluation of loss	<ul style="list-style-type: none">• One major injury (finger amputation)
Type of contact	<ul style="list-style-type: none">• Cut by object
Immediate cause(s)	<ul style="list-style-type: none">• 10 cm of the cutting blade was left exposed• Sliding table or pusher was not used
Basic cause(s)	<ul style="list-style-type: none">• Ineffective machine guarding• No safe work method or engineering control for handling large and irregular-shaped frozen meat• Provision of work gloves were unsuitable for the task
Failure of WSH Management System	<ul style="list-style-type: none">• Lack of risk controls were put in place to eliminate or minimise exposure to the cutting blade

Case 3

Worker Loses Finger when Working with Band Saw



RECOMMENDATIONS & LEARNING POINTS

1. Provide effective guarding to minimise exposure to the cutting blade.
2. Provide workers with suitable gloves for the task (e.g., consider using cut-resistant stainless steel mesh gloves or layered gloves with an inner layer for thermal protection and an outer layer for food hygiene). These gloves must be form fitted to each worker. This is to make sure that the gloves do not introduce draw-in hazards when working with a band saw.



Figure 3c: Example of cut-resistant mesh gloves used in butcheries

Case 3

Worker Loses Finger when Working with Band Saw



RECOMMENDATIONS & LEARNING POINTS

3. Design and fabricate a customised sliding table and adjustable gripper to handle large and irregularly-shaped frozen meat. The design should make sure that workers do not have to use their hands to directly hold the frozen meat as it goes through the cutting blade.
4. Conduct specific risk assessment and implement safe work procedure (SWP) on the safe use of band saw machine for cutting various types and sizes of meat.
5. Provide the necessary supervision especially for new or inexperienced workers, so that workers are aware of the risks and able to carry out the work safely.
6. Consider automating the meat cutting process (e.g., using a meat block auto feeder) so as to eliminate the man-machine interface, thereby making the process inherently safer.

Case 4

Worker Struck by Fallen Window Sash



DESCRIPTION OF INCIDENT

A worker was cutting bean curd at a factory manufacturing soy bean products when a window sash¹ (made of metal) suddenly fell towards the worker and struck her on the forehead.

The injured worker was quickly sent to the hospital but she subsequently passed away about an hour later.



Figure 4a: Fallen window sash measuring 3.6 metres tall and 2.2 metres wide.

¹ A window sash refers to the part of the window assembly enclosed within the window frame which holds the window panes.

Case 4

Worker Struck by Fallen Window Sash

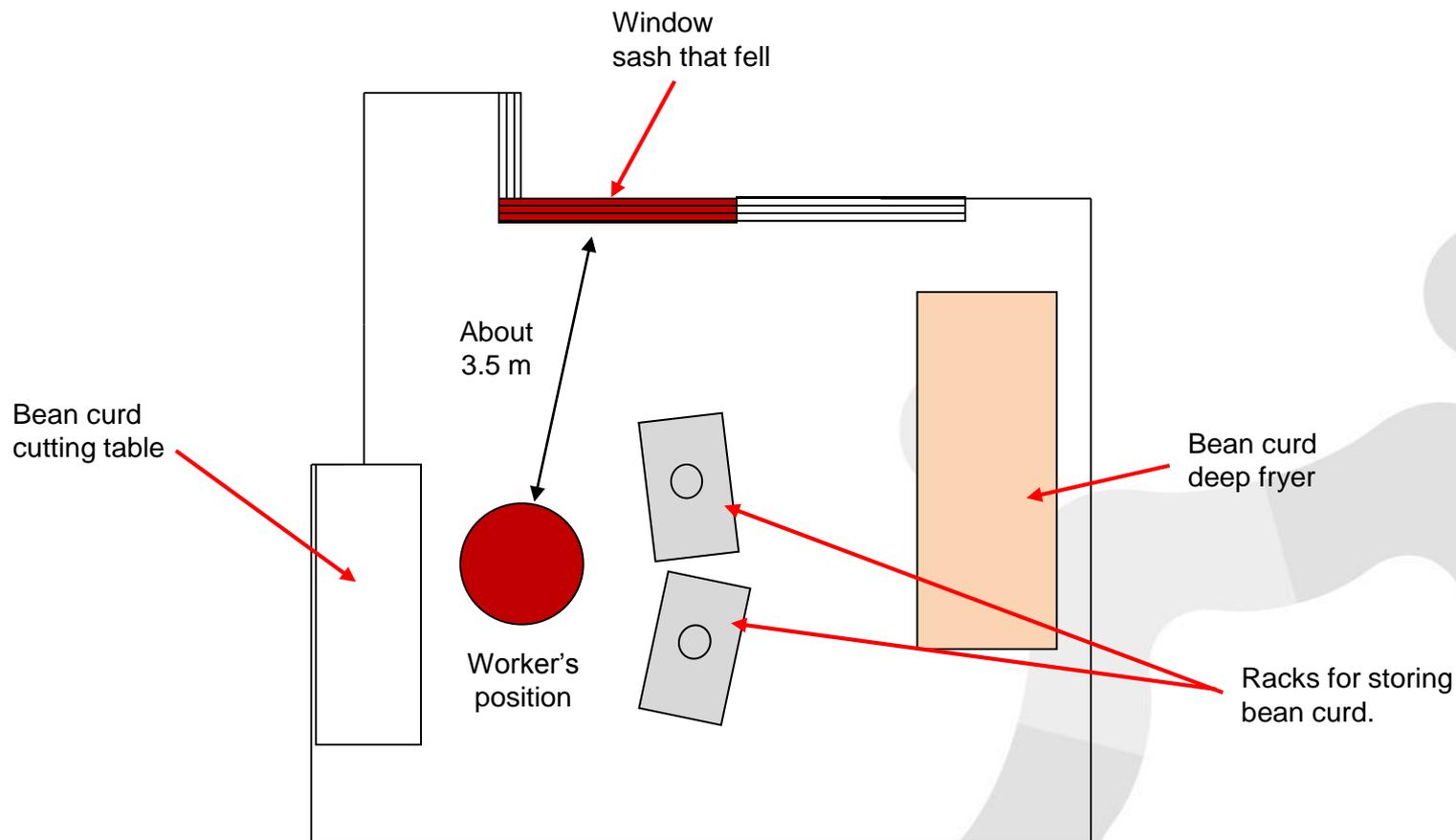


Figure 4b: Layout plan showing the relative position of the worker to the window sash.

Case 4

Worker Struck by Fallen Window Sash



POSSIBLE CAUSES & CONTRIBUTING FACTORS

MISSION

- The worker was cutting bean curd near a rusty window sash.

MACHINE

- The window sash was badly corroded in some areas.

MANAGEMENT

- There was no facility maintenance regime.

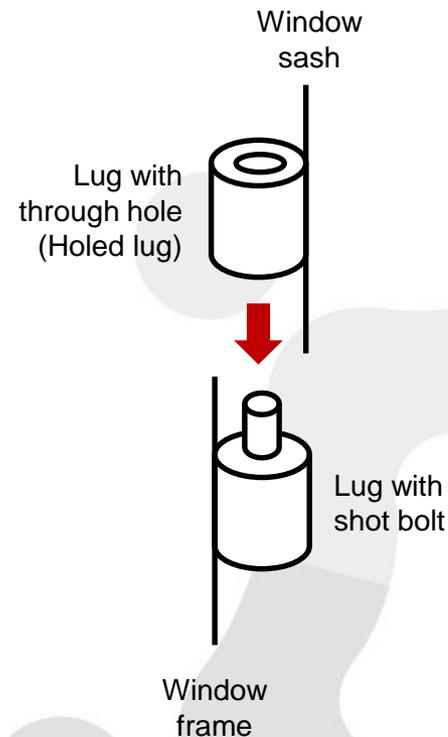


Figure 4c: Illustration showing how the window sash is attached to the window frame.

Case 4

Worker Struck by Fallen Window Sash



CAUSAL ANALYSIS

Evaluation of loss	<ul style="list-style-type: none">• One fatality
Type of contact	<ul style="list-style-type: none">• Struck by falling object
Immediate cause(s)	<ul style="list-style-type: none">• The window sash was supported only by its top hinge. Two out of three hinges had their holed lugs broken off from the sash due to severe corrosion.
Basic cause(s)	<ul style="list-style-type: none">• Failure to inspect and maintain the window
Failure of WSH Management System	<ul style="list-style-type: none">• No preventive facility maintenance regime

Case 4

Worker Struck by Fallen Window Sash



RECOMMENDATIONS & LEARNING POINTS

1. As the work environment in a food manufacturing facility can be potentially hot, humid and/or oily, implement a preventive facility maintenance regime to make sure that the workplace remains safe for everyone on the premises.
2. Incorporate workplace facility inspection into the housekeeping checklist. A periodic inspection of the windows would have revealed that the hazard was caused by a corroded window sash. Early identification of the hazard would have called for measures (e.g., window part replacement or painting to reduce the rate of corrosion) to be taken to prevent the window sash from deteriorating to such a state that it could collapse from its supports.
3. The use of aluminium alloy for windows is recommended. The relevant Singapore Standard is SS 212: 2007 Specification for Aluminium Alloy Windows. Refer to Building Control Act and the Building Maintenance and Strata Management Act for more information.

Case 5

Worker Died after Slip and Fall at Bread Factory



DESCRIPTION OF INCIDENT

A worker slipped, fell and hit her head on the floor at the bread cooling area of a factory at about 1.30am. She became unconscious and subsequently passed away at the hospital.



Figure 5: Scene of the accident where the worker slipped and fell.

Case 5

Worker Died after Slip and Fall at Bread Factory



POSSIBLE CAUSES & CONTRIBUTING FACTORS

MISSION

- The worker was walking to the freezer to check on something after office hours.

MEDIUM

- The floor outside the freezer was slightly wet due to condensation.

MAN

- The worker was wearing her own footwear.

MANAGEMENT

- No anti-slip mat or flooring was provided and there was no hazard signage to alert workers to the presence of a slippery floor.

Case 5

Worker Died after Slip and Fall at Bread Factory



CAUSAL ANALYSIS

Evaluation of loss	<ul style="list-style-type: none">• One fatality
Type of contact	<ul style="list-style-type: none">• Slip and fall
Immediate cause(s)	<ul style="list-style-type: none">• Slippery floor• Worn out footwear
Basic cause(s)	<ul style="list-style-type: none">• Slippery floor due to condensation outside freezer• Failure to identify the slipping hazard
Failure of WSH Management System	<ul style="list-style-type: none">• No measures taken to mitigate the slipping hazard• Absence of hazard communication to workers• Lack of enforcement regarding the use of and condition of safety footwear

Case 5

Worker Died after Slip and Fall at Bread Factory



RECOMMENDATIONS & LEARNING POINTS

1. Provide workers with appropriate non-slip footwear.
2. Implement a footwear inspection programme where footwear is checked regularly (e.g., every 4 to 6 months) for wear and tear, and replaced as necessary.
3. Increase the floor slip resistance (e.g., use non-slip tiles, apply a slip resistant coating on an existing walking surface, or strategically place anti-slip mats and anti-slip tape/stickers). For more information on floor slip resistance, refer to SS 485: 2011 Specification for Slip Resistance Classification of Pedestrian Surface Materials.
4. Carry out regular floor inspection and maintenance to make sure that floors are in good condition and remain safe for use. If the floor becomes slippery (e.g., due to water or oil) during the course of work, specify in the safe work procedure the requirement to dry or degrease the floor as often as reasonably practicable.

Case 5

Worker Died after Slip and Fall at Bread Factory



RECOMMENDATIONS & LEARNING POINTS

5. Provide suitable hazard signage to indicate slippery floor or cleaning is in progress. This will help to raise the awareness of the on-site slipping hazard.
6. Train workers to identify slip hazards at their respective workplaces and educate them on various anti-slip control measures.
7. Make sure work areas are sufficiently illuminated so that workers would be able to see any slipping hazard along their path of movement and clearly see any hazard signage.
8. Make sure that workers have sufficient rest. Long hours, shift work and strenuous activity can cause fatigue and will reduce one's alertness to hazards in the work environment.
9. The RA needs to be reviewed whenever there are changes to the cleaning method or cleaning contractor.

Case 6

Worker's Hand Caught in Meat Mincer

DESCRIPTION OF INCIDENT

A worker was operating a meat mincer machine to mince cuttlefish into paste in the processing room of a fish ball manufacturing company.

The worker accidentally dropped a cuttlefish head into the feeding orifice. He inserted his left hand directly into the feeding orifice to remove it and his fingers came into contact with the rotating worm of the meat mincer. His left hand was drawn into the throat and crushed by the meat mincer machine.

The worker was rushed to the hospital with part of the mincer machine still attached to his arm. His left hand had to be amputated.

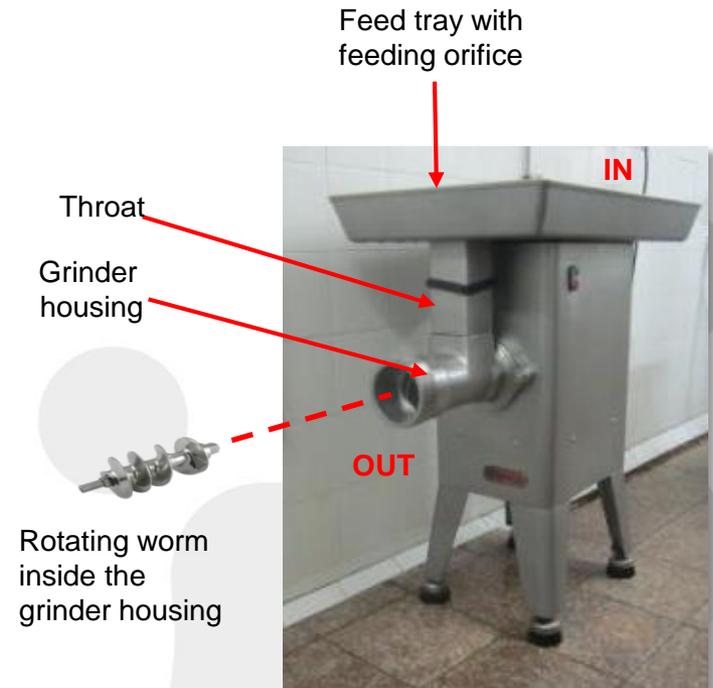


Figure 6a: Typical industrial meat mincer

Case 6

Worker's Hand Caught in Meat Mincer



POSSIBLE CAUSES & CONTRIBUTING FACTORS

MISSION

- The worker was operating a meat mincer machine to mince cuttlefish into a paste.

MACHINE

- There was no guarding at the feeding orifice of the meat mincer.

MAN

- The worker inserted his left hand directly into the feeding orifice.

MANAGEMENT

- There was no warning sign to alert workers of the machine hazard.
- Poor implementation of risk control measures.

Case 6

Worker's Hand Caught in Meat Mincer



CAUSAL ANALYSIS

Evaluation of loss	<ul style="list-style-type: none">• One major injury (hand amputation)
Type of contact	<ul style="list-style-type: none">• Caught in machine
Immediate cause(s)	<ul style="list-style-type: none">• Worker inserted hand into feeding orifice
Basic cause(s)	<ul style="list-style-type: none">• No physical safeguard to prevent hands from entering the feeding orifice
Failure of WSH Management System	<ul style="list-style-type: none">• Inadequate risk controls• Absence of hazard communication to workers

Case 6

Worker's Hand Caught in Meat Mincer



RECOMMENDATIONS & LEARNING POINTS

1. Carry out a specific risk assessment (RA) and/or job safety analysis (JSA) for all activities involving each type of meat mincer machine in use.
2. Develop a safe work procedure (SWP) for the meat mincing activity, help workers to understand the risks associated with the task, and train workers to carry out the procedure. In the event that access into the throat of the meat mincer is necessary, workers must ensure that the meat grinder is fully de-energised and Lockout Tagout (LOTO) implemented before attempting access (e.g., by using a long stick).
3. Install a physical guard at the mouth of the feeding orifice so that it is not possible to insert one's hands into the throat of the meat mincer.



Figure 6b. Guarding installed to protect hands and fingers from contact with the rotating worm

Case 6

Worker's Hand Caught in Meat Mincer



RECOMMENDATIONS & LEARNING POINTS

4. Provide a push stick (or a pair of tongs) which workers can use to safely push meat towards the rotating worm of the meat grinder during operations.
5. Install warning sign on the meat mincer to alert operators of the presence of machine hazards.
6. Conduct a comprehensive equipment review at the point of purchase to ascertain the risks arising from machine operation and the adequacy of existing safeguards.



Figure 6c. Push stick specially designed to go through the guarding and towards the rotating worm

Suggested References



- Workplace Safety and Health Act
- Workplace Safety and Health (Risk Management) Regulations
- Workplace Safety and Health (General Provisions) Regulations
- Code of Practice on Workplace Safety and Health Risk Management
- WSH Guidelines on Safe Use of Machinery
- WSH Guidelines on Contractor Management
- WSH Guidelines on Good Housekeeping
- WSH Guidelines on Fatigue Management
- Guide to Total Workplace Safety and Health – Holistic Safety, Health and Wellbeing in Your Company
- SS 212: 2007 Specification for Aluminium Alloy Windows
- SS EN 420: 2003 Protective Gloves – General Requirements and Test Methods
- SS 485: 2011 Specification for Slip Resistance Classification of Pedestrian Surface Materials
- SS 506 – 1: 2009 Occupational Safety and Health (OSH) Management Systems
 - Part 1 – Requirements

Suggested References (cont'd)



- SS 506 – 1: 2009 Occupational Safety and Health (OSH) Management Systems
 - Part 2 – Guidelines for the Implementation of SS 506 – 1: 2009
- SS 508: 2013 Graphical Symbols – Safety Colours and Safety Signs
 - Part 1 – Design Principles for Safety Signs and Safety Markings
 - Part 2 – Design Principles for Product Safety Labels
 - Part 3 – Design Principles for Graphical Symbols for Use in Safety Signs
 - Part 4 – Colorimetric and Photometric Properties of Safety Sign Materials
 - Part 5 – Registered Safety Signs
- SS 513: 2005 Specification for Personal Protective Equipment – Footwear
 - Part 1 – Safety Footwear
 - Part 2 – Test Methods for Footwear
- SS 531 – 1: 2006 (2013) Code of Practice for Lighting of Work Places – Indoor
- SS 537 – 1: 2008 Code of Practice for Safe Use of Machinery – General Requirements
- SS 567: 2011 Code of Practice for Factory Layout – Safety, Health and Welfare Considerations
- SS 571: 2011 Code of Practice for Energy Lockout and Tagout

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Thank you

