

International Journal of Recent Advances in Multidisciplinary Research  
Vol. 02, Issue 06, pp.0446-0454, June, 2015



## Review Article

### RISK ANALYSIS IN THE PRODUCTION OF WINE

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#### ARTICLE INFO

##### Article History:

Received 15<sup>th</sup> March 2015  
Received in revised form  
19<sup>th</sup> April, 2015  
Accepted 25<sup>th</sup> May, 2015  
Published online 29<sup>th</sup> June, 2015

##### Keywords:

Wine growing winery,  
Risk identification,  
Preventive measure.

#### ABSTRACT

The wine industry is one of the most important in Cuyo. Considering the entire wine sector, it can be mentioned that there are associated risks with growing vine, secondly, the associated risks with the process of winemaking. This agro-industrial activity are marked by high transience of workers. At harvest time, the largest number of workers is concentrated, since the contracting meets the needs of growing grapes and special specified conditions for wine making. In addition, there are many production processes, depending on the oenological practices that are carried out at each of the wineries. On the other hand, currently all companies must implement obligatory prevention systems that are able to ensure the safety and health of workers as established in Argentine National Security and Health at Work Law, Number 19587. Industrial accidents are a major physical, psychological and social. Also occupational claims ratio is a social prejudice in the worker's environment, and in turn, economic decline, since in most cases involves the absence or incapacity to perform productive activity. Therefore, in this paper, despite the multiple processes of winemaking, unacceptable risks identification is performed, considering all the possibilities of winemaking. The identification and assessment of risks are fundamental to establish the necessary preventive measures in order to minimize the threat, which generate in the physical, mental and social integrity of the worker. Then, each risk was analyzed and evaluated. Mitigation measures implementation are proposed for identified risks in each stage of this industrial activity. In practice, these measures reduce the frequency and / or severity of a hazardous event. Subsequently different prevention measures, such as process control and organizational measures are proposed.

#### INTRODUCTION

The wine industry in our country has an important social and economic role, as the setting of the population in rural areas and an important environmental function, and it is practically the only crop, which has a perfect adaptation to Mediterranean climatic conditions that they can be given in certain areas like Cuyo. The domestic grapes production, in 2013, was 2871.7 tonnes, which are made into wine 2786.1 tonnes. The total wine production in Argentina this year was 14983356 hl, where the largest producer is Mendoza with 11775478 hl, followed by San Juan with 2322806 hl. Moreover, 21592845 hl of must were produced, being the largest producer, the province of Mendoza (www.inv.gov.ar). The wineries are marked by high transience of workers. At harvest time the largest number of workers is concentrated, since the contracting meets the needs of growing grapes and special specified conditions for wine making (Grainger and Tattersa, 2007).

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Considering the entire wine sector, it can be mentioned that there are associated risks with growing vine, secondly, the associated risks with the process of winemaking, which include the receipt of the grapes in the winery to shipping the finished product. Based on the need to study the types and causes of accidents at work in the wine industry, this paper begins with the characterization of them to provide a series of recommendations to the companies in the sector to enable an effective prevention. Currently all companies must implement obligatory prevention systems that are able to ensure the safety and health of workers as established in the National Security and Health at Work Law, Number 19587 and its Regulatory Decree Number 351 / 79. Thus, it offers a new vision of work security, allowing fully integrated the preventive action into the overall management system of the company (Ley Nacional N° 1987).

#### 1. Identifying potential risks

There is a relationship between accidents and temporality, hiring temporary employment, the existence of shift and night

work, the age of the firm and employed prevention systems. Industrial accidents mean a major physical, psychological and social harm to the worker, who suffers. In addition to the physical and psychological injuries caused, work related accident is a social prejudice in the worker's environment, and, in turn, economic decline, since in most cases, it involves the absence or incapacity to perform the production activity (Martín del Moral, 2006). The identification and assessment of risks in each process of winemaking are fundamental to establish the necessary preventive measures in order to minimize the threat, which generate in the physical, mental and social integrity of the worker.

The followed procedure in this work is schematized in Figure 1.

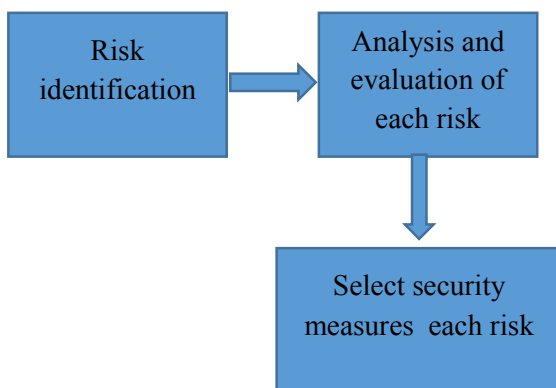


Figure 1. Followed procedure scheme in this work

## 2.1 Potential associated risks to the harvest

The associated risks with the agricultural machinery-operation are accentuated according to the geographic location or terrain. Regarding geographical location, plantations inclusion in hill slopes is especially noted, which has added an additional risk to the machinery work under these conditions (Cardona, 2005; Clusif 2009; Glendon *et al.*, 2006).

### 2.1.1 Associated Risks with the use of tractor

The main associated risks with the use of tractor are rollover risks, entrapment risks and risks of people falling from tractor. The basic cause of rollover accident is the result of: topographical features of land, operational failures at which includes overweight aspects, poor loading aspects and poor mechanical conditions of tractors and heavy equipment. Poor coupling between tractors and loading equipment, lack experience of worker. Accidents happen on tractors, which transmit movements or forces to coupled equipment through power take-off and loading axles. These accidents are due to loss of protection of the transmission line, which remains in operation and has not been decoupled at the time of connecting to equipment or reviews when it is in motion. Gears and pulleys at which involve also entrapment, in many cases at time of falling or tripping over them.

It is common in agricultural work especially crops the use of trailer to freight transportation, which means a risk of people falls, jumping on the bandwagon to download or accommodate the burden on them and also be used as transport elements within the grounds or gardens. Under these conditions occur

falls at the time that the carriage is moved by the tractor, without verification of the people existence on them. These cars generally are used to transport staff, without meeting with the people transporting security.

### 2.1.2 Associated Risks with use of pesticides and fertilizers

Pesticides are intended to control the action of pests, weeds, bacteria and other harmful animal or plant life forms for agriculture, also including pesticides, defoliant, desiccants and plant growth regulating substances. During the application of pesticides there is a wide risks range: poisoning, irritation, burns, inhalation, ingestion or skin contact, mainly exposure via dermal absorption due to the large number of manual tasks, which are performed in the vine cultivation.

### 1.1.3 Associated risks with outdoors working

Outdoors working means any labor, which is performed under outdoor conditions. People who perform these activities are mainly exposed to exposure to insect bites and weather such as: UV radiation, exposure to heat and rain.

### 2.1.4 Associated risks with manual labor

Manual tasks to be performed in land, such as the vintage, pruning or installing trellises are hard work, which causes injury and pain in back, arms and hands more than any other issue health. One third of the injuries that cause workers to miss work are musculoskeletal disorders related to work, commonly known as sprains and strains, and a quarter is caused by back injuries. These are also the most common cause of disability. Sprains and dislocations are caused by excessive movement while stretching, bending, lifting, loading, grasping objects, squatting or twisting the hands, shoulders or body. Generally, any work done with great force, manual tools, with many repetitions or an unnatural position is risky. Even a movement which in itself is not dangerous, and reach out to grasp an object, or tightening tool, you can put workers at risk of injury if repeated over and over again.

## 2.2 Associated Risks with winemaking

During the production process is carried out several tasks whose order and duration depend on the winemaking technique [Glendon *et al.*, 2006; [www.conectapyme.com/documentacion/2010Agricola.pdf](http://www.conectapyme.com/documentacion/2010Agricola.pdf), Meyers *et al.*, 1997]. Figure 2 shows, by way of example, the white wine production process (Grainger and Tattersa, 2007).

### 2.2.1 Associated Risks with download vintage

The risks can be found in this process are mechanical risks, risks of people falling from heights, crowds risks and abuse and exposure to sulphur dioxide risks. Within mechanical risks can be mentioned those arising out of the use of machinery and moving parts, as they can be crushing, shearing, cutting and sectioning, hook, trapping or thrust, impact, perforation or puncture, friction or abrasion, solids projection or fluids. The risk of people falling from heights is constituted by the risk of falling into the hopper, mainly. The crowding and abuse risks occur in spring discharge, where the trailers wait to deposit their load on the receiving hopper.

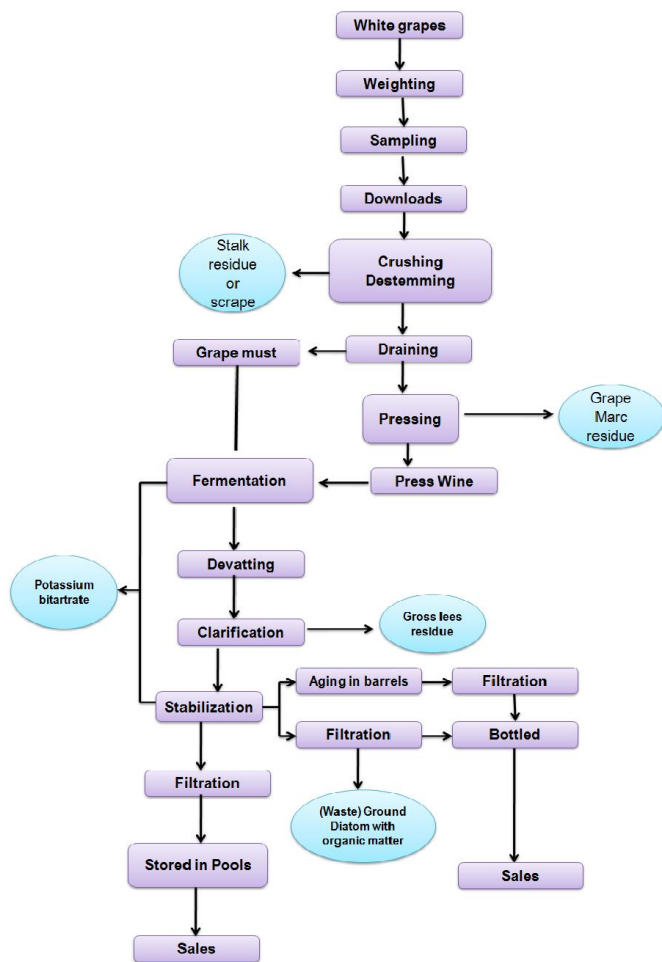


Figure 2. Flow sheet of wine production process

Finally, the associated risk with the  $\text{SO}_2$  use, which is used as an antioxidant, antiseptic and solvent, is based on the ability to combine easily with the water, forming sulfurous acid first, then sulfuric acid, which can penetrate into the organism in three ways: respiratory, digestive and skin

### 2.2.2 Associated Risks with Most production

During this stage crushing and stemming is performed where a stemmer aspirator removes stems. To carry out the crushing, roller crushers are used, which are adjustable according to the size of grapes and crushing strength are used. Vintage pumps and pipes are also used. The main risks that can be found at this stage are the risk of entrapment in the operating point, punches, trapping and / or electrical contacts with bombs and fall on different levels since must is driven by pumps to deposits intended for that purpose.

### 2.2.3 Associated Risks with fermentation

This process includes wine receiving, processing, and preparation before bottling, for this stage it is used mobile transfer pumps and racking hoses that lead must to deposits. They can be self-emptying (with sloping bottom, to facilitate removal of the residues or solid) or have a system of propellers or paddles with different types of closure. The risks that occur during this stage are the blows risks or risks of entrapment with elements of racking, falling from heights and exposure to toxic substances ( $\text{CO}_2$  and caustic soda).

### 2.2.4 Associated Risks with pressing, racking, aging, clarification and filtration

During these winemaking stages it is had the following risks: people falling (due to spills) from different level, pushing around due to hand forklift. Barrel movement from one area to another, discomfort by wet process, detached objects fall (during stacking of casks), entrapment, cutting, and electrical contacts ( pumps and hoses use), shock and / or cuts (barrels handling), burns (due to use of sulfur pellets), exposure to toxic substances ( $\text{CO}_2$ , cleaning products and potassium metabisulphite).

### 2.2.5 Associated Risks with Bottling

The bottling process starts with the washing, which begins with manual or automatic bottles palletizing. For this task often it is used sharp tools such as cutter, knives or knives and mobile platforms at height. Then the bottles go to the rinsing. Then it is proceed to filling and corking. Finally labelling and packaging are performed. The worker performs the capsules supply and barcode labels. Boxes or bags of these materials are manipulated by him and are usually deposited on foot line. After production machine glue residue is cleaned, hot water and rags are used and the workplace is ordered. The risks that occur during this stage are the risk of falls from heights (during the scrolling over the pallets or palletizing operations), bumps and cuts, falling object due to manipulate and / or collapse, fragments projection, entrapment, electrical contacts, exposure to noise and chemical products (cleaning products, hazardous substances such as glues and resins during labeling, etc.)

### 2.2.6 Associated Risks with packaging, palletizing, aging, storage and dispatch

During these stages the following risks can be mentioned: Elements fall, shock and / or entrapment, people fall from different levels, electrical contacts, and outages.

### 2.2.7 Derived Risk from ancillary activities performance

The risks, which are arisen from the auxiliary tasks that will occur in winery, such as administration, laboratories and maintenance are: strokes risks and cuts risks, (scissors, staplers, drills, guillotine, drawers, sharp edges, etc.), fall at the same and from different levels (from ladders, elevated work areas, holes or openings, etc., or due to soil characteristics, or poor workplace organization), electrical contacts, noise exposure, contact with chemicals, fire risks, associated risks with equipment data screen and local conditions (temperature, air movement, humidity, etc.), overexertion risks, objects fall or crash, bumps and / or cutting with objects or tools, added risks from transit through winery, projection risks, beatings risks, entrapment risks and associated risks and welding burns risks.

## 3 Preventive measures

To achieve the objective, which is pursued by the legislation and regulations in occupational risks prevention, a change in the company safety culture is necessary in order to give more importance to prevent work-related risks and bet strongly for the companies prevention integration.

The occupational risks prevention is immediately applicable, reduces workplace accidents and generates savings to employers. It is set as main objective to assist all wine sector workers in order to create safer work spaces, manage effectively the performance in occupational risks and reduce workplace accidents in the sector. This will affect both improved safety and health of workers, and better preventive management and company productive resources.

### 3.1 Preventive measures at harvest

#### 3.1.1 Recommendations to avoid associated risks with the tractor use

- Tractor and agricultural equipment drivers should be qualified and trained in driving and operation thereof.
- Monitoring should be implemented as a management system that includes the workers safety within the supervisor's responsibilities. Supervision should help to assess industrial safety within the company.
- Preventive maintenance programs both tractors and farm equipment should be implemented. These programs should be based on the operation and maintenance manuals for agricultural equipment.
- Select both tractors and tow trucks according to the type of task.
- The worker must constantly keep an eye on driving conditions to prevent running over, beatings and other accidents.
- The technical information required for the operation and maintenance of tractors and farm equipment should be known by their drivers and operators.
- While larger wheelbase (length axis) greater security. Of course, it must be compatible with the culture.
- If it is driving at high speeds, it should place the bolt lock brake pedals tractor.
- It does not try to change gear once started movement. It is recommended that the ground slopes should not exceed  $18^\circ$  for the longitudinal work and not more than  $11^\circ$  to  $13^\circ$  ( $20\text{--}25\%$ ) for side works. All tractors which work in earrings conditions should have anti rollover protection bars.
- Do not drive in the vicinity of slopes, banks of ditches or other depressions. Drive at a safe distance is recommended.
- A marked slope it should rise reversing and should descend forward, in order to the tractor is always in the same direction.
- The seat belt must be used only if the tractor has a suitable structure. Today it is possible to attach a security structure to tractors which do not have it.
- The towed and dragged carriage should have safety chains coupled between the cart and tractor drawbar, which act in case of release of both bars from attachment point.
- The used tractor on sloping work must be double traction wheels.
- The tractor and pulled or dragged equipment must be in good mechanical condition, especially the brakes and good tires.
- The coupling point between tractor and towed trailers or other equipment must be properly secured in hitch point with pin and cotter. The heavy trailer hitch must be made at the lowest point.

- Loads to transport on cart or towed trailers must not exceed the tractor capacity and take into account the terrain. The standard indicates that the weight to be transported must correspond to the effort that can support the coupling of two drawbars. The load should not exceed the net weight of the tractor.
- When tractors move with suspended weights on hydraulic systems (plows, harrows, sprayers, etc.), it must secure a position available, regarding the hydraulic system. To prevent lateral movement of the suspended agricultural implement, it should avoid the lateral movement that occurs when the tractor is moving on roads with potholes, stones and others.
- By any reason it can transport people in the tractor or attached equipment to it. Tractors and farm equipment do not have any safe place to transport passengers.
- The first recommendation suggests that all transmissions of motion must have protection to cover completely the entire area of transmission. These protections must meet standards of strength and design to cover effectively the transmission points. Guards should be complete and well maintained at points of protection.
- Establish working procedures for the equipment coupling and uncoupling to movement transmission lines. Should indicate clearly the operation sequence, tight-fitting clothing use, tools and other supporting elements.
- Workers who drive or operate tractors and machinery with force or motion transmission must ensure that protections are in place and they protect the transmission line.
- If machinery is moving, do not fix at the transmission points.
- Worker should not be placed near transmission motion points, especially if it is wearing loose working clothes.
- If the motion transmission system stops because of system failure, jamming or other reason, it should check out if the whole line is stopped or disconnected from the engine to the transmission.
- Consider also final line inconclusive movement of the operating point. For example: Mower blade line, which is blocked by a rock.
- When agricultural machinery maintenance is made and the protection (to review and performance the moving parts maintenance) is removed, they must be replaced in its entirety once the work is completed ([www.conectapyme.com/documentacion/2010Agricola.pdf](http://www.conectapyme.com/documentacion/2010Agricola.pdf), Meyers *et al.*, 1997; Hollnagel *et al.*, 2013)

#### 3.1.2 Recommendations to avoid associated risks with pesticides and fertilizers use

##### During storage

- Local storage should have the sign at the entrance "Chemical store room" and the symbol of danger. The room should be dry, ventilated and gateway must have lock and key. It must also be clear of flammable materials such as fuel, stalks, etc.
- The electrical protection must have adequate protection, so if a short circuit occurs, the spark does not come into contact with the air in the store, since it can be flammable or explosive due to the emission of gas products.

- It is forbidden to light cigarettes, install stoves or fireplaces in the local storage.
- Products are stored sorted and separated by utilities (insecticides, herbicides, fertilizers, etc.). Will be placed on shelves, so that in lower regions the less toxic products are located, and in the upper the most toxic.
- The used containers should be sealed to avoid spills and releases of products. It is preferable to use appropriate size containers to the pesticide amount, which will be used.
- If it produces spills because of ruptured or failed containers, it proceeds to clean the contaminated sites with absorbent elements, which are collected and treated as hazardous waste.

#### During transport

- Pesticides should be transported in safe and sturdy packaging. It must avoid any shock or friction, which may affect the content. It must transport separately from other materials.

#### During treatment

- Use only approved products. They must be properly labelled and have their safety data sheet. Do not buy products in bulk since it means a risk of accidents or errors and consequently a health hazard. It should follow the given instructions in the label product.
- Use less toxic and more specific products for the pest which it will be treated, where technical advice is needed. It is important to respect the security timing of products application.
- The pesticide application must be made upwind and in sequential sense to it, so that toxic clouds that form and parts of the treated area should be avoided.
- Don't blow or suck clogged nozzles, either through the rubber tubes to siphon the products from a container to another one.
- The machines used for the treatment will be used only for this purpose.
- It must not be eaten, drunk or smoked during the treatment. In any case, hands and face must be washed with soap and water before doing it.
- Use the appropriate personal protective equipment: Neoprene or nitrile gloves (leather gloves are invalid), diver protection, boots, eye protection and respiratory protection (mask filter paper is insufficient). At a minimum it is recommended to use A2-B2-P3 filter; in any case consult with the seller of the product.
- Wear long nozzle sprays, reducing enough worker exposure to pesticide, if it is possible.
- If workers have wounds or abrasions on the hands, they should not be involved in the preparation and / or application of pesticides.
- After treatment:
- Wash wore clothes and if it is necessary, review or change the personal protection in order to keep it in perfect condition.
- If there are remained residues after products treatment, they will be stored in airtight containers properly labeled with the product name, composition and toxic word perfectly visible.

- The packages will be treated as hazardous waste.
- The deadlines for safety must be accomplished before harvest or the entry into the treated area ([www.conectapyme.com/documentacion/2010\\_Agricola.pdf](http://www.conectapyme.com/documentacion/2010_Agricola.pdf), Meyers *et al.*, 1997; Hollnagel *et al.*, 2013).

#### 3.1.3 Recommendations to avoid risks associated with outdoors works

- Dispose always of water near the workers, who should usually consume it. It is important to rest for acclimatization.
- Wear appropriate clothes, caps, hats and use protective creams during sunny days. Avoid wearing black coloured clothes, so it is better to wear white coloured clothes.
- Regarding insect bites exposure, it is necessary to have appropriate antihistamines. Avoid people making vintage work with insect bites hypersensitivity.
- Long sleeves and trousers must be provided to exposed workers in order to cover the skin from the sun and stings.
- Avoid working outdoors during a rainy day.
- Provide warm clothes and at the same time they must not permit the accumulation of body sweat.
- Ingest warm liquids to recover the lost temperature in case of rain or cold conditions. Pay more attention on protecting the limbs because they are more susceptible to the cold than the rest of the body.
- Wear several layers of clothes because through this way is easier to insulate the cold and if it is warm, you can remove the layers. Wear waterproof insulated boots to avoid getting wet [www.conectapyme.com/documentacion/2010\\_Agricola.pdf](http://www.conectapyme.com/documentacion/2010_Agricola.pdf), Meyers *et al.*, 1997; Hollnagel *et al.*, 2013.

#### 3.1.4 Recommendations to avoid risks associated with manual tasks

- The number of workers for the handling of wires, strips of wood, etc., in the installation of the trellis must be enough.
- Take the cluster at the base, never by the tail because of the risk caused by the scissors or knife cutting.
- It is important to wear gloves against mechanical risks, without losing the dexterity.
- Do not jump between ridges and ditches.
- Wear a proper footwear.
- When tools require strength, the size of the handles must allow the worker to take around the handle so that the index finger and thumb are superimposed on 0.375 ". The diameter of the handle should be between 1.375" for workers whose hands are small and 2,125" for workers with large hands, considering an average of 1.75 ".
- Handles must be covered with a smooth non-slip material (plastic or rubber). The double-handled tools (such as shears or pliers) must have a handle length at least 4 "and preferably 5". They must have a spring device or spring to keep the tool opened and the handles must be almost straight without finger grooves position.
- Take special care during the loading and unloading of harvest baskets to reduce the risk of falls.
- Keep the lifted load between hands and shoulder level. Avoid lifting load from the floor or above shoulder level.
- Use containers with handles or knobs.

- Reconfigure the loads in order to lift them close to the worker body.
- Provide trolleys, wheelbarrows, carts or objects to be transported for more than some feet.
- Keep load weight below 22.68 kg. Perform periodic breaks during harvest [www.conectapyme.com/documentacion/2010\\_Agricola.pdf](http://www.conectapyme.com/documentacion/2010_Agricola.pdf), Meyers *et al.*, 1997; Hollnagel *et al.*, 2013.

### 3.2 Preventive measures in the wine production

#### 3.2.1 Recommendations to avoid risks associated with discharge vintage

##### Mechanical risks

- Work always with the original machine guards, above all the moving parts of it.
- Greatest care in cleaning, maintenance and / or removal of the stalk, especially if it is done manually.
- Place guardrails that limit the access to machinery and protect the worker.

##### Risk of falling at different levels

- Only qualified winery staff must work in this region.
- Use lifting platforms which are a system composed by two ramps online, one for placement of the trailer and another frame that hides inside the hopper.
- Ramps must be clean and dry.
- To prevent workers falling into the hopper, it must be around protected by guardrails. On its surface, give it a series of horizontal metal sections, forming a grid and located less than six feet above the level of the bottom out feed units away.
- Walkways must have nonskid floor.
- It is essential that the platform and the worm have a triggering device in a control room and out from the one where the worker may have a broad vision of receiving hopper, controlling the process all the time.
- Usar cinturones o arneses de seguridad con sistemas de sujeción para los operarios que efectúen tareas de descarga.
- Use safety belts or harnesses with restraint systems for operators who carry out download tasks.
- The screw should have emergency shutdown systems placed in visible and easily accessible place.
- Awnings trailers must be removed, because they reduce visibility and can cause serious injury if released unexpectedly into the hopper.
- When performing any work or task within the hopper, turn off the machine and remove the safety key.
- Develop protocols and safe discharge procedures which are known by workers who perform these tasks.

##### Risks of outrages and agglomerations

- In order to download basket in a comfortable and safely form, stairs with treads and metal grille must be provided.
- Respect the turn of arrival in the discharge line, stand safely without causing obstructions of traffic, and do not leave the vehicle cabin without first checking that the security conditions of the area are the most suitable.

- Put signs and warnings about this risk in the loading dock area.

##### Risk of exposure to SO<sub>2</sub>

- Make a responsible use of SO<sub>2</sub> since an excess dose does not imply greater efficiency, with special attention to leakage.
- The effects of splashes must be prevented.
- The container must always be labeled and the security tab hanged from it. Make periodically a review of the cylinder, valves, metering devices or injection, etc., must be kept separate from raw materials, in a well-ventilated area. Handling must be performed only by trained and experienced people.
- If this product is used in solution, it always must be used protective airway, such as masks with chemical filters.
- Avoid the risk of contact with hands using waterproof gloves in order to use against organic chemicals.
- When high product concentrations are produced in the work environment, which could cause eye irritation in workers, wearing eye protection and / or tight goggles are advised.

#### 3.2.2 Recommendations to avoid risks associated with must obtaining

##### Risk of trapping

- Do not remove the original protection of the crusher.
- Do not repair or operate the machine when it is running.
- Flag all the time the danger and prohibitions described above.

##### Risk of falling at different levels

- In order to access to the top of the tanks, it is important that the placement of the stairs is adequate. They must be adequately protected. Hallways and walkways must have high anti-slip base and intermediate rails and skirting bar.
- It is very important the order and cleanliness of these surfaces to prevent falling both operators and objects that can injure people working at lower levels.

##### Risk of punches, trapping and / or electrical contacts with pumps

Protection against trapping must be provided in order to protect connections and circuits from moisture (Hollnagel, 2013; EN 61346-1. 1998).

#### 3.2.3 Recommendations to avoid risks associated with the must fermentation

- Put in racking elements, a lattice similar to the hopper, where the operator must not stand or lean on the upper edges of racking equipment, although they have that protection.
- Check the stability of the ladder used to access operations to tanks or pits, using harnesses and mechanical lifting systems and always being carried out work teams and procedures: an operator must be outdoors and staying attentive. If the worker inside notices any symptoms of

suffocation must pull the rope to be rescued by the employee who watches, being able to be necessary to have to use the rescue equipment with oxygen tank, installed for that purpose in this area.

- The design of the winery and its construction shall consider that it must not access inside the tanks to perform processing tasks. Building underground spaces are also avoided as trenches for the location of strippers and crushers, etc. and the construction of underground tanks that only have one or two top openings.
- It is advised that the reservoir is aerated before entering it, staying on the fan until after the racking. In addition, the lamps used to illuminate the tank must have safety handle, appropriate level of protection to moisture and they will be fed up by voltage. The employee will be relieved periodically. The same precautions must be observed for all those tasks whose access within the deposits is required.
- Regarding the use of detection equipment and ventilation it is recommended by first the use of specific detector material Dual Alarm (audible and visual) and remote probe which sensor must be replaced regularly. Secondly, ventilation equipment are recommended being the most effective those that introduce air into the bottom of the tank by a centrifugal or radial fan and must have the correct dimensions. It is also important that there is adequate forced ventilation in fermentation vessels and in all low areas where CO<sub>2</sub> can be accumulated.
- If caustic soda is used, the staff responsible for handling this product knows the risks of exposure.
- The application of epoxy paintings in vats and reservoirs ensure less difficult removal of tartar and solid particles that get stuck on the walls after fermentation, preventing full utilization of this substance.
- If it cannot avoid its use, the use of appropriate personal protection equipment is recommended, such as masks and gloves (Hollnagel, 2013; EN 61346-1. 1998; Youakim, 2006).

### 3.2.4 Recommendations to avoid risks associated with pressing, racking - breeding, clarification and filtration

- Wear always safety footwear, possessing non-slip soles and reinforced toes.
- The ships must have water drainage channels and must be covered with grates.
- Possible spills which occur during pressing, must be removed immediately to prevent the surfaces are slippery.
- Don't place or rest on the top of the presses.
- The operators who handle forklift and pallet trucks must be trained in their use and informed of the risks that their use may produce.
- The transport speed of the trucks must adapt to different areas, because it affects the stability of them. All trucks will comply with the safety regulations, performing regular maintenance, according to the established by the manufacturer. The use of seat belts on forklifts will be binding and it will be followed all the time diagram of the truck loads, never outdoing the capacity of the last one.
- Signpost properly the routes of movement in the winery.
- When movements of musts deposits are made they should be kept closed when scrolling the top floor and if they are open must be available fall protection or grids which allow

the aeration of wine, but that at the same time protect against this risk.

- Handrails shall be preserved in good condition, to be revised periodically. These must have a height of 90 cm, spacer bar and 15cm skirting.
- When the transfers are made and these barrels are stacked, they must take appropriate measures to prevent falls during this operation, such as the use of harnesses or not exceed the recommended stacking height.
- The use of stacking systems which reduce the manual handling of the barrels and increase the safety of the process avoid the crash. Within these systems, it may be mentioned the sleepers, which must be regularly checked to assess their good condition.
- It is forbidden to stand under the barrels when they are being manipulated with tweezers at the carwash. Periodic machines maintenance will be carried out, especially their security, according to the manufacturer's instructions
- The responsible staff for these operations must be properly trained.
- Transfer pumps must have protection against crushing and their connections and circuitry should be suitably protected against moisture.
- In the barrels car wash vicinity, it should not work with bracelets, pendants, rings or other elements, which may increase the risk of entrapment or catching on moving parts. If the workers have long hair, it should be collected. Cuff of sweater and shirts must be adjusted.
- Do not enter the limbs into the machines mobile areas if they are running. If it needs to handle hazardous elements, it must disconnect the machine from energy source and it must signpost.
- The handling automation of the barrels will prevent accident.
- It must manipulate the sulphur pills avoiding direct contact with them, through the use of protective gloves.
- Indicate the suffocation danger caused by carbon dioxide and make a location study of detectors on the premises and ensure good ventilation of spaces.
- Know the safety data sheets of handled chemicals as cleaning products. Use appropriate protective equipment such as gloves and boots, or respiratory and eye protection.
- Staff should know the exposure risks to potassium metabisulphite. It must use appropriate gloves, eye and respiratory protection to prevent dust may contact with the mucous membranes (Hollnagel, 2013; EN 61346-1. 1998; Youakim, 2006).

### 3.2.5 Recommendations to avoid associated risks with bottling

- The stack stability of bottles must be assured.
- For works that exceed 2 m in height, worker must wear seat belts.
- If a semi automatic machine, which collects and supplies the bottles to the bottling line, is used, the worker is on a mobile platform, which must not exceed one meter in height for depalletizing upper layers of the pallet. The operation will be performed at ground level in order to depalletize low layers.
- To avoid shock and / or cuts, cutting tools must be used with caution and must be used protection gloves.

- If it removes broken bottles, it must use appropriate gloves to prevent cuts and it must use dustpan and pusher to avoid the contact with the cutting edge.
- The loads must be properly balanced and the fork must be centred under the load.
- The safety boots use with reinforced toe is recommended.
- It must wear safety glasses and clothes, which cover the entire body to avoid the risk of projected fragments.
- For cleaning, if it uses blowing compressed air, it must use a nozzle on a disc as a shield and as a pressure setting, which exceed not one atmosphere.
- It always ensure before removing connections, the lack of pressure in the hoses and appropriate connections.
- It suggests proper signage to prohibit access to the moving parts of the rinsing area to unauthorized personnel.
- Improve work posture to reduce the overexertion.
- The access to machinery moving parts must be protected to minimize electrical hazards. The maintenance operations must be performed after disconnecting the equipment and it takes steps to prevent accidental starting.
- To reduce the exposure to noise risk, placing methacrylate panels to isolate the equipment from the rest of the ship is recommended.
- If the worker access to sound risk areas, he must be equipped with appropriate personal protective equipment.
- Areas of the winery, where the use of hearing protectors can be recommended or obligatory, are signalled. Periodic examinations will be performed for exposed workers.
- To reduce the use of chemicals risk, workers must know the risks of exposure to them and the manufacturer's recommendations for use and handling.
- For the management of labelling, it must wear appropriate gloves and masks to the chemical, which is being applied (Hollnagel, 2013; EN 61346-1. 1998).

### 3.2.6 Recommendations to avoid associated risks with packaging, palletizing, aging, storage and forwarding

- To avoid falling bottles, it is recommended to check the correct operation of: the arm that moves them and the safety devices. The bottles never go above other workers.
- Protect access to line machinery moving parts and transmission, which move to avoid bumps and entrapments. Protect access to these areas with fixed guards.
- Do not put pallets in places, which are not designated and it must kept clean and tidy the workplace in order to reduce the falling risk.
- To avoid overexertion, it is recommend to perform frequently small pauses. It also forms and informs workers about postural care loads.
- To reduce electrical hazards, it must perform correctly signalling in the electrical panels and controls, having previously coached the worker in case of jamming and specific actions.
- Use safety footwear with reinforced toe and slip-resistant soles to prevent possible accidents.
- Maintenance of proper orderliness and cleanliness. is essential. It must educate and inform workers that it is forbidden to place on specific mechanisms for loading, or on top of it.
- The workers, who manipulate forklift trucks and pallet trucks, must be trained in its use and it must signpost

properly the passageways (Hollnagel, 2013; EN 61346-1. 1998).

### 3.2.7 Recommendations to avoid performing ancillary activities risks

- Do not use sharp and / or cutting tools for uses, which have been intended.
- It must inform at all times the damaged equipment.
- It must have drawers with locking device that prevents output guides.
- It is recommend the furniture installation with rounded edges.
- The work area must have adequate signage.
- It places and uses correctly the stairs.
- It ensures elements of them and it places slip supports.
- Set in elevated work areas, intermediate rails or bars.
- Keep access roads and clear steps.
- Cover the ground with firm nonskid avoiding irregularities.
- Route the cables along the walls, collect, cover or signpost those, which cannot be placed.
- It must provide to maintain order and cleanliness of the infrastructure.
- Performance regular electrical installations and equipment reviews by qualified personnel.
- Check for proper operation of circuit breakers, isolating the active parts.
- In case of breakdown, it must voltage disconnect, communicate and make the damage repaired by authorized personnel.
- The switchboards must be secured and marked.
- It must train workers about the risks of direct and indirect electrical contacts.
- Purchase working teams, taking into account the level of noise produced under normal work. Have proper maintenance thereof too.
- The noisy areas facing windows must have double window pane.
- Inks, adhesives, ozone, and any chemical used also in the laboratory, must be properly labelled and have their safety data sheets. It must consider comply with the manufacturer's instructions for handling and it does not mixtures of products, which are not specified. At the same time, the storage of hazardous chemicals must be performed at appropriate places, in closed and labelled containers.
- To avoid fire risk, flammable materials must be stored in areas away from heat sources.
- Electrical equipment must be switched off if they are not in use
- Smoking is banned.
- Do not expose the printer cartridges to excessive heat or flame.
- Have fire extinguishing equipment, training workers on their use. Perform regular maintenance of them.
- Signpost and clear the emergency exits. Conduct fire drills.
- To avoid risks from the use of computers for data visualization, it must use height-adjustable chairs and wallpaper and set short and frequent breaks.
- Leave enough space in front of the computer keyboard because of the hands can rest on the table and adjust the



height of the keyboard to the user's needs. Having a stable stand and adjustable footrest if it is necessary. Not place the workplace or front or back to the window.

- Adapt the lighting intensity to the visual needs of the task.
- Eliminate or shield sources of dazzling light.
- Maintain proper cleaning and regular maintenance of lamps and lighting fixtures, fixing them if they are damaged.
- Prevent reflections on glass and data visualization screens.
- Have a good installation of air conditioning and heating vents correctly oriented. Avoid drafts.
- Use tools and ergonomically designed furniture to avoid awkward postures.
- Adapt the workspace to the worker's needs.
- Facilitate postural changes and breaks in the working day
- In order to avoid accidents during task performance sample collection, it must be properly maintained the vehicle, make a proper work planning and order it, avoid the rush and help the driving experience safer.
- During laboratory tasks is essential to maintain order and cleanliness. In case of spills shall be cleaned. In addition it must be used personal protective equipment. It is forbidden to eat or smoke in the laboratory.
- It must be made a regular review of the electrical system, making secure connections, avoiding joints anyway and signaling electrical panels.
- Store the products testing the stability and compatibility of them.
- There will be a first aid kit, properly signposted, hung and whose situation must be known by all workers
- In maintenance tasks, it must be verified the correct operation of the emergency stop, end positions and machine guards.
- The connections to the electrical panels are always made with the corresponding pin.
- Portable lighting equipment must have insulated handles and shock protection.
- Trapping points such as conveyor belt, pumps, etc. must always be protected.
- For jobs that exceed up to 2m, it must be wore an fall arrest system.
- In order to avoid the risk of burning, it must be wore hand guards and suitable work clothes for welding work (Hollnagel, 2013; EN 61346-1. 1998).

#### 4 Conclusion

The wine industry is one of the most important economic activities in the Cuyo region.

There are now many production processes, depending on the oenological practices that are carried out at each of the wineries. Despite the multiple processes of winemaking, this paper has considered all the possibilities of winemaking. In this work, it has been applied the concept of risk analysis to the whole process. It has been emphasized at all stages of the technological process and identified potential risks and hazards, considering from grape growing to wine production and storage and were raised measures that reduce and / or eliminate risks and the occurrence of accidents and incidents.

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