

SIMULATION OF MACHINES FOR MECHANICAL OPERATION OF GRAPES IN WINERY

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Abstract

This paper presents the mechanical operations in the processing of grapes in wine-making process. In the software package SolidWorks modeling was performed for certain machines used in wineries and then performed a simulation of these machines. Based on the simulation of machines and harmonizing the operating parameters of the designed model it creates a base and determines all relevant parameters for the final construction of machinery. This procedure reduced the time of making final technical documentation.

Keywords: wine, machinery, SolidWorks, simulation, technical documentation

2. INTRODUCTION

Serbia has a great potential in wine making industry, especially in area of small family wineries. Several regions are famous for their wines but lack of proper equipment force many winemakers to buy machines that are expensive and oversized. In order to make accessible but quality machines for mechanical operation of grapes

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during wine making process in 2012, we started a national project "Serbian mini winery" in which was defined most of equipment for small scale wineries. These wineries should have area under vineyards no more than 5 ha [1], which is the most common case in small family wineries. During the period of project it was defined a technology and process of making wine and grape treatment and basic plan how the winery should look like (figure 1).

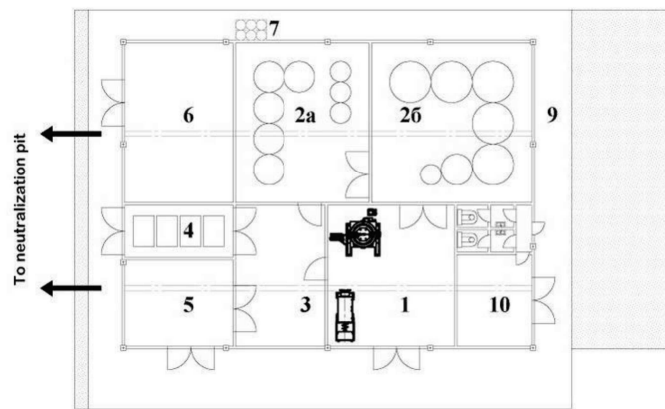


Figure 1. Basic plan for small scale winery

First, the grapes are brought from vineyard on the handling porch (9) mostly in crates. All grapes go to machines that are called crusher and press (1). There are few differences in making white or red wine [5] and one of these differences is that grapes for white wine goes on crusher and right after that on the press and juice is filled in tanks (2a). A grape for red wine goes into the crusher and then it goes in special tank for process called maceration. After maceration pomace goes to press and grape juice goes to tanks (2b). Depending of technological terms, after fermentation wine goes for bottling and is ready to go into the market (3). Rests of the winery are storages, worker rooms and cooling system [4].

In this paper will be described two machines that were mentioned before: grape crusher-destemmer and press. It will be shown also their 3D models and principals of work.

3. CRUSHER DESTEMMER

Crushing grapes is a first step that we start a production of wine from grapes. We are crushing grapes in order to extract grape juice with its berries. This task should be executed in that way that we don't damage the solid part's of grape (like seed inside a berry) but just hard enough to that grape berry skin breaks and juice gets out. This procedure is very important so it allows yeast to come in contact with a grape juice and do alcohol fermentation. Also by crushing grape we are making it easier for press to separate a liquid part and solid part of grape berries (berry skin and seeds) [6].

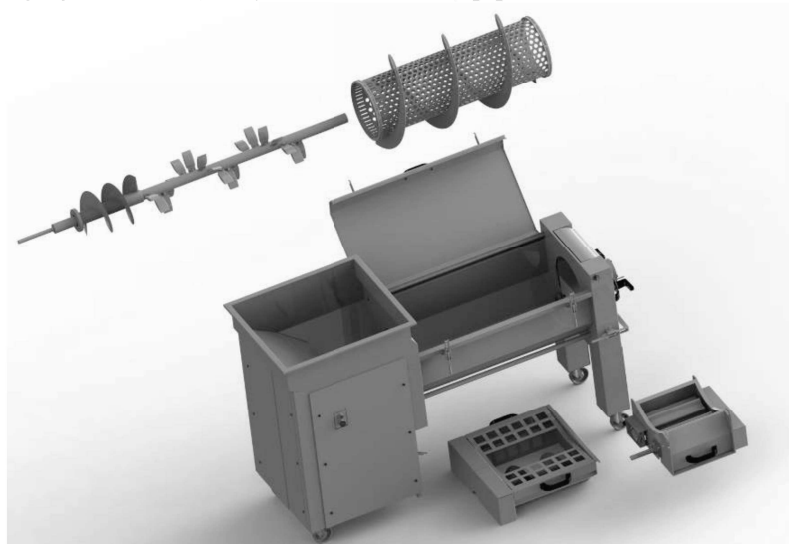


Figure2. Crusher destemmer whit parts

Crusher destemmer (Figure 2) is a machine that is using to separate the grapes themselves from the stems and then to split open the grape in order to get at the sugary juice inside that is going to be fermented.

Operating principle goes throw several phases. Grapes are going throw hopper to screw conveyer which has a function as dozer for amount of grapes to transport to shaft with arms and paddles. Destemmers comprise a perforated cylinder, with a shaft equipped with paddle-like arms running through its center. When the shaft turns, it draws in the grape clusters and expels the stems out the other end. The juice, pulp and grape skins pass through the perforations. A quality

destemmer should not leave any berries attached to the stem. Reciprocally, the stem should not be impregnated with juice. The stem should also be entirely eliminated, with no broken fragments remaining. To accomplish wanted goal working parts of destemmer have a specific geometry (figure 3 and figure 4) [2].

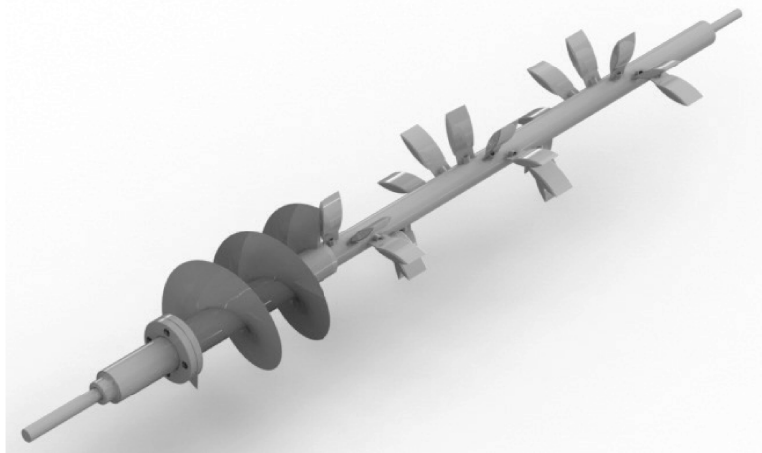


Figure 3. Shaft with arms and paddles

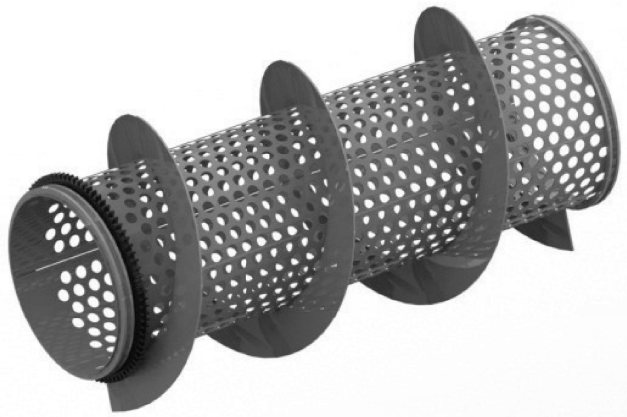


Figure 4. Perforated drum

As it was said, destemming grapes is done by two rotating elements: drum (figure 3) and shaft with arms and paddles (figure 4). Inside element (shaft) rotating in mathematically positive direction while outside element (drum) is rotates in opposite direction. On shaft first we have a screw conveyer that is used to dose amount of grapes before it goes to arms with paddles which separate grape and stalk. This is an example of how geometrically different elements are used for current function.

Outside element (figure 4) have a spiral plate around perforated drum which has a function to move grape berries back for further processing. Throw perforated drum grape berries are going to rolls and stem are going outside. With this characteristic geometry of these two elements we have gain accurate destemming which has as a result a better wine quality.

4. PRESS

Wine press (figure 3.) constructed for small winery has a unique design that makes it cheaper to made and easier to handle. It consists of:

- 1) Support structure
- 2) Head of press
- 3) Protection shield
- 4) Tank

Basic principle of operation of this specific press is that when tank is placed pumping three rubber tires head of press is moving down for a 350 mm. After that head is getting back up and released a dissenter that presses the grapes for more 300 mm more. Whole pressing path of head is about 650 mm or less depending of type of grapes and quantity of dry mater in the tank. After grape is pressed juice is going to tank for storage for fermentation [3].

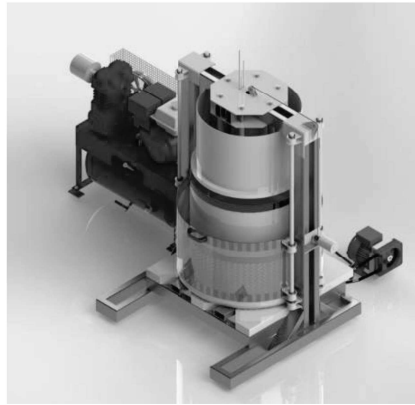


Figure5. Wine press

5. FINAL REMARKS AND CONCLUSION

For all machines described above there are made models in program called Solidworks and it has been simulated their work. As a practical result of these models, for example, we have a kinematic scheme of grape crusher-destemmer (figure 5) on which we can see all rotating speeds of all moving parts.

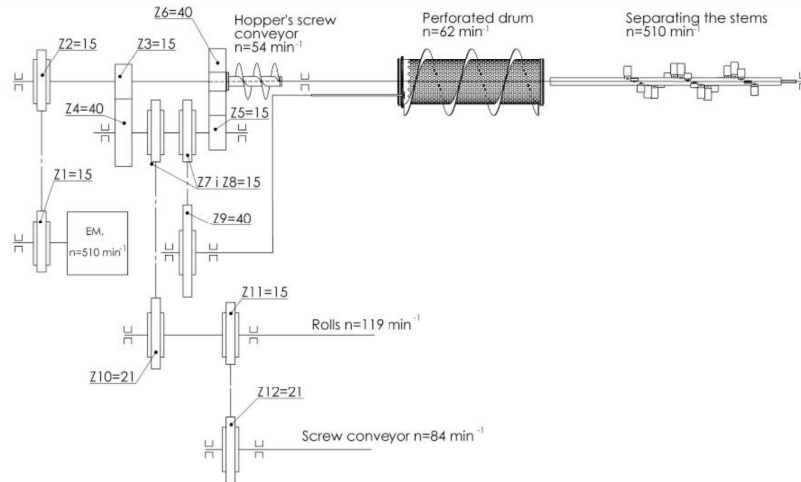


Figure 6. Kinematic scheme of grape crusher-destemmer

This paper present a good example how to use theoretical knowledge, in this case, in field of Descriptive geometry, and thus to solve a practical problem. Solution we explain in this paper is elegant, but very efficient.

In oral presentation it will be shown simulation in which is very clearly shown how these machines work and their assembling from parts.

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