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A SURVEY REGARDING THE PERFORMING DRYERS USED IN MARC CAPITALIZATION TECHNOLOGIES

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Abstract: In the current context of the waste capitalization technologies development designed for wine industry focus on the aspect of integration in industrial flows that respect the concept of circular economy and thus the economic process sustainability is justified on medium and long term. A representative part of the process waste of wine is grape marc (skins and seeds). The grape seeds have a particular importance because they are used to obtain nutritionally valuable oils, and the drying process can damage the final raw product quality, from this reason in this paper are presented some advanced equipment's
Keywords: dryers seeds, mark capitalization, seed qualities, mark technologies

INTRODUCTION

The marc capitalization technology used by the wine producers are mainly used to obtain bio-fuels but due to latest research in Phyto-pharmaceutic field revealed that the fresh mark can be used also as an important source of oxidants and valuable compounds for the human health, and in many other related fields (animal and fish feeding, soil bio-nutrients, etc.). Taking in to consideration that wine industry is present on all continents, the technical and environmental potential and impact has a great impact, for this reason the regenerative systems "is a must", because the resource input are the wine waste, emission, and energy leakage are minimized by slowing, closing, and narrowing energy and material loops.

The means to achieve circular economy, respectively "long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, recycling, and upcycling" (Geissdoerfer, M, at all, 2017), is in contrast to linear economy which has a production model like 'take, make, dispose'. (Ellen MacArthur Foundation, 2012).

In favor of the circular economy approach is mentioned the next arguments: to achieve a sustainable world does not involve to change product quality and consumers purchasing power; doesn't require loss of revenues or extra costs for manufacturers and other economic agents. But the circular economy focuses on areas such as design thinking, systems thinking, product life extension, and recycling, in order to achieve models that are economically and environmentally sustainable, idea supported by most researchers and experts in the field of economy.

Based on the circular economy principles, the study of feedback-rich (non-linear) systems are similar to particularly living systems (Ellen MacArthur Foundation, 2012) and its practical applications to economic systems evolved incorporating different features and contributions from a variety of concepts sharing the idea of closed loops. Some of the relevant theoretical influences are cradle to cradle, laws of ecology, looped and performance economy, regenerative design, industrial ecology, biomimicry and blue economy. (Geissdoerfer, M, at all, 2017)

In 2017 in order to provide guidance to organizations that implement circular economy strategies, the British Standards Institution (BSI) developed and launched the first circular economy standard "BS 8001:2017 Framework for implementing the principles of the circular economy in organizations. Guide". BS 8001:2017 standard, intend to align the far-reaching ambitions of the CE with established business routines at the organizational level. It contains a comprehensive list of CE terms and definitions, describes the core CE principles, and presents a flexible management framework for implementing CE strategies in organizations. Circular economy monitoring and assessment is given, but it missing the consensus yet on a set of central circular economy performance indicators applicable to organizations and individual products.

This fact is generated maybe, because there are not yet implemented this system and the environmental polices strong enough to stimulate and reward the participants, or because the sanctions and fines have no impact on the phenomenon generators enough to stop and mitigate the contaminated sites.

Wine trade between the EU and third countries excels, with exports reaching the level of 6,7 billion euro, in 2010, almost a quarter of European exporters of agricultural products. Economically speaking, European production plays a strategic role, having in to consideration the fact that in 2016, the wine market turnover reached 377 million euro and it is estimated that in 2017 to be 385 million euro, reaching the highest level in recent years. The Romanian market place in the big wine producers in the world is placed on 13-th position, next to Portugal (6,6 mhl), Hungary (2,9 mhl) and Austria (2,4 mhl), and is among the few European countries that have registered an increase compared to 2016. According to KeysFin analyses, after more than 10 years of changes and reorganization, wine sector business has come close to maturity. (Chiriță C., 2018)

In Romania from approximately 1 million tons of grapes used to processes wine, are obtained 120,000 tons of marc without bunch and 400,000 hectoliters of yeast. Usually from 1 tone of grapes it is made 1.2 [kg] of tartaric acid, 180 [kg] of marc and 4.5 [kg] of yeast, and by processing the marc and yeast is resulted 8.8 [l] alcohol, approximate 22 liters of yeast brandy of 40 % vol. (Pomohaci Nicolai, 2002).

If we apply the concept of circular economy in Romania, the innovative technology to capitalize marc is perfect integrable and can create a valuable chain reaction, see Figure 1, and in the main beneficiary is the human being for the food product (wine, grape seed flour and oil) and phyto-pharmaceutical.

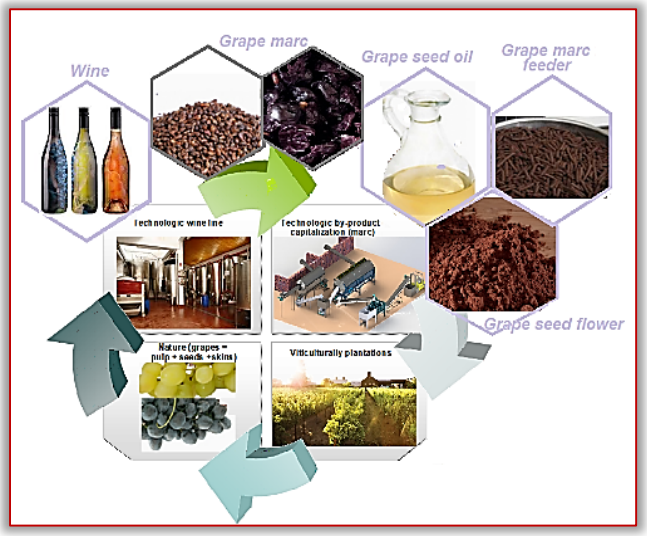


Figure1 - An example of wine technological process combined with marc capitalization technology respecting the principle of circular economy (Milea, et all, 2018)

In some cases, the direct beneficiaries are the farm animals (bio concentrates with high nutritional intake in the form of pellets – as it is implemented in Nebraska Screw Press company) and the farmers because in the soil management process can be integrated the bio-fertilize technologies, namely bio-compost (fertilizers, if using the earth worm technology - one of the newest applications in the field) (Domínguez J., at all, 2016).

MATERIAL AND METHOD

Taking in to consideration the technological aspect of agro-ecosystem sustainability and ecological aspects of waste recycling, the INMA presents an innovative technology to recover the vineyard by-products, in accordance of newest trends in this field of activity, see Figure 2.

This technology its working upon a logical order to ensure the technological grape seed separation from skins, in accordance with specific processes of secondary material, which can be later capitalized in multiple ways and new products.

As it can be noticed, in this technology it is presented a primary segregation equipment that has a washing unit, this unit it is optionally, but it is necessary in case fresh marc separation followed by obtaining high quality grape seeds used for grape oil extraction. Furthermore, within the marc/grape seed technological flow is used drying equipment's, this operation is important because it influence the purity and quantity of grape seeds (Pomohaci Nicolai, 2002) and is stipulated that the maximum temperature to be 110°C, in order to assure a humidity of 11÷12% during the conservation/deposition period and to provide sterile conditions to inhibit the growth of acetic bark and mildew lead to the degradation of extractives.

Usually in industrial technologies are used convective driers, typically the wet grape seeds come into contact with the drying agent, hot air or combustion gases, from which it receives by convective process the heat required by drying process; in most cases the drying agent is air.

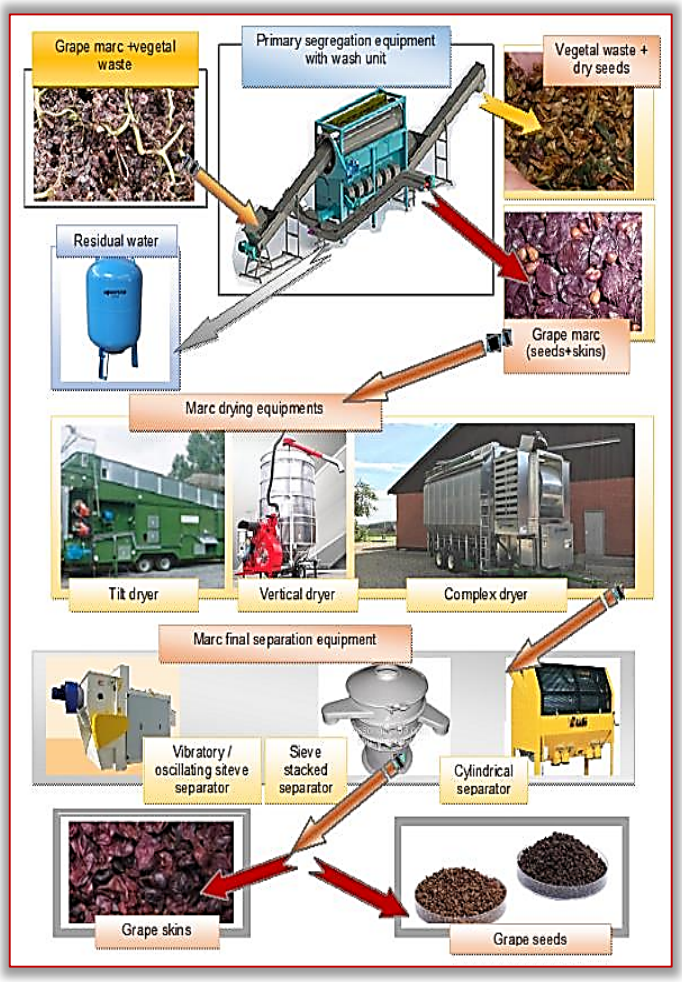


Figure 2 - Innovative technology to capitalize preclean grape marc (Milea, et all, 2018)

In the drying technique, outside of this type of dryer are also used: the intermediate heating dryer, the recirculation dryer, the recirculation and the intermediate heating dryer, and also the closed-circuit dryer. This large verity is influenced by the technologic flow placement, material low (in charge or in continuous flow), and the heating agent flow or with energy saving circuit. In the next paragraph will be presented several types of commercial driers.

RESULTS

Various stages of the technological process to capitalize the grape marc, are used for drying of, either whole material or its components, shells and seeds. In the following, some constructive variants will be briefly presented.

Intermediate heating dryer. From this category, on the market is the Alvan Blanch continuous double flow drier, is manufactured by UK and it is promoted also by Rusland company from Russian, because has in its construction a transport chain which takes the material on two ding levels: the upper level for hot-air drying and the lower level for cold air treatment to prevent hot spots when stored.

Also, this equipment is used on USA seed processing technologies to decrease from 25 % to 9 %, the temperatures that can be achieved are from 70 until 110 [^{0}C]. An advantage is to remove particles of dust and chaff from the processing material, the light

part is discharged through the upper air vents into the collector box, and the heavier part is deposited at the base thereof. This system is necessary to reduce the risk of fire. The automatic control system ensures the flow control and the sensors placed on the power supply signal if there is no material, and there are also sensors for detecting possible blockages, overheating of the grain, overcharging of the motors and burner failure, as well as stopping the equipment in case of failure.

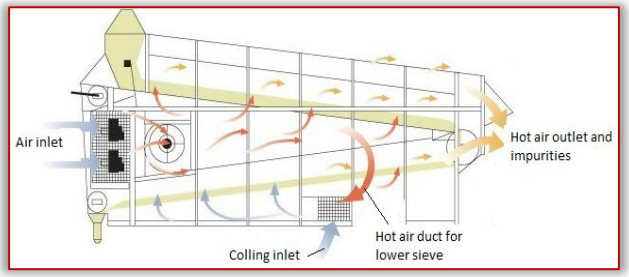


Figure 3 - The working principle of the continuous flow dryer [10]

Another constructive solution for chare flow dryer is the model presented in Figure 4, manufactured by PEDROTTI company from Italy, this model also can be found manufactured by the ex-communist states (like: Russia, Hungary, etc.). According to its spreading, it is noticed that this system is the favorite of seed/cereal processors and its technical advantages appreciated and used at large scale. This drying system is in line with technological developments and can be easily adapted to the processors needs.

Figure 4 - PEDROTTI trailed vertical dryer [11]

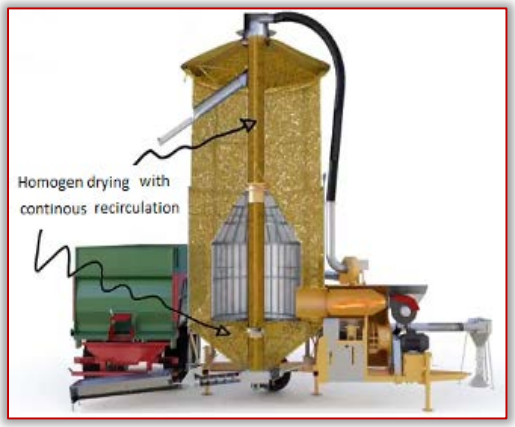
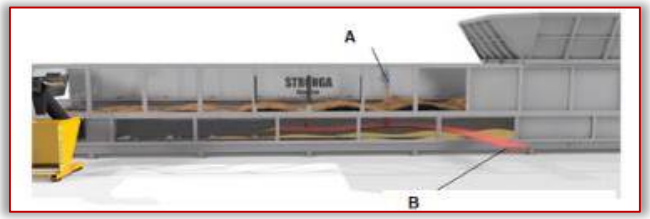


Figure 5 - Grain vertical dryer – FSN [12]

The Mecmar Company has the FSN model, see Figure 5, to dray cereals, sorghum, grape seeds, etc., in a closed loop circuit. This equipment was designed to make 5 operations: supplying, draying, cooling, impurities selection and evacuation, and this working capacity can vary.

Recirculation dryers can be with different structures and gauges, apart from the model shown in Figure3 can be presented also the high humidity dryer manufactured by Stronga company. In Figure 6, is presented the working principle and the main components. The working draying principle is mainly the hot air diffusion in all processing material due to the belt transportation conveyor that generates also a waving motion.

a)



b)

Figure 6 - High humidity cereal and granular materials dryer [13]
1-supplay bunker; 2-programable control station; 3-pulsing draying belt;4 – go forth scraper transport system; 5- outlet opening; 6 -thermic isolation; 7 – transversal conveyor for small particles; A- diffusion hot air flow; B- hot air inlet provided by HEATEX.

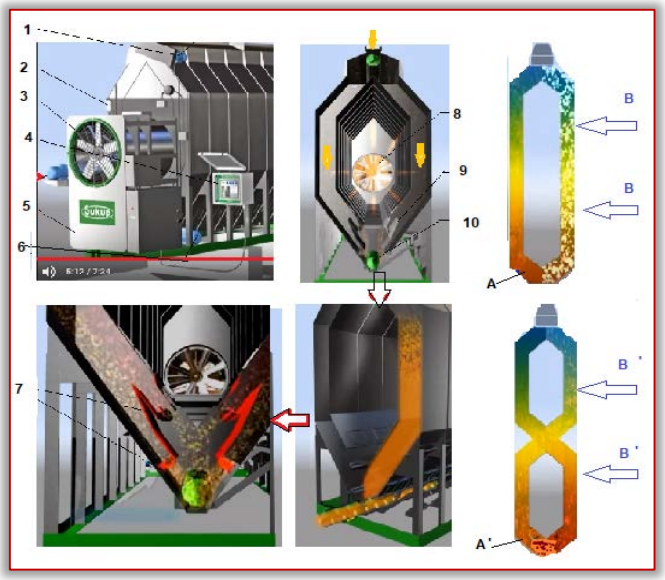


Figure 7 - FSN cereal/seed dryer working principle and patent drying solutions [14]
1-engine to supply conveyor; 2-process lighting boll; 3-ventilation system; 4- control and command panel; 5--heat generator; 6-seed outlet conveyor engine; 7-seed flow distributor 8-heating source; 9-distribution and weighting system; 10- outlet system with sensors; A and A'- drayed cereals; B and B'-cold air flow-wind.

SUKUP dryer, manufactured by DANCORN, has an interesting design and the drying process is fully automated and controlled, see Figure 7. Thus, model has a complex structure with modular construction and patented heating circuits with recirculation system in order to recover energy and optimize drying operation, constructing a closed-circuit dryer equipment. This model also is provided with innovative elements to assure maintenance and easy replacement of the moving parts.

Recirculation and the intermediate heating dryers, are used at large scale, such systems are rotative dryers, as develops the WESTPRO company, see Figure 8.

Figure 8 - Tubular rotative dryer [15]

These solutions are used mainly to industrial scale and have low maintenance, because: low cost of spare parts; low labour; are self-centring and do not have gears or chains which can easily be swallowed. Usually their dimension is external diameter of 0.6÷2.7 [m] and length of 0.4÷1.65 [m]. Depending on the processed material humidity, the rotary drum is provided with various ravaging systems, such as longitudinal and radial vanes (Figure9), wings (Figure9 b-f), helical profiles (Figure 9.g and j), dedicated profiles for different types of materials and their combinations (Figure9. k, m and n).

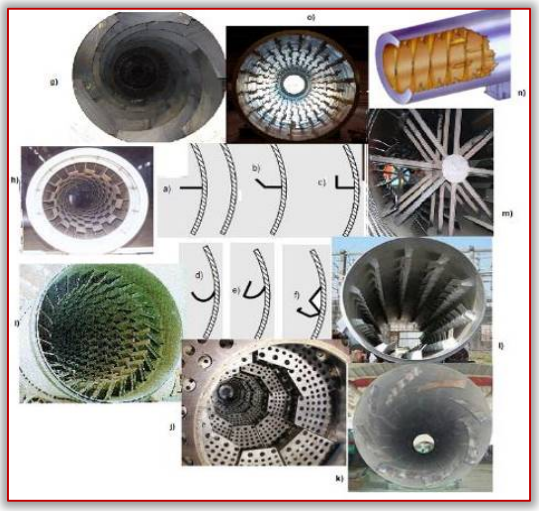


Figure 9 - Rotary drum is provided with various ravaging systems

In USA the company Economy Industrial have manufactured combined drying systems and separations of the solid granular materials with high humidity. The constructive solution is presented in Figure9.and presents 4 sectors: fan induction system; a rotary dryer; a rotating screen for separating the material and a heating system. For the maintenance of the separation element (sieve/sieves), a brush system parallel to the sieve axis is also provided to detach the wet material from the orifices of the rotary sites.

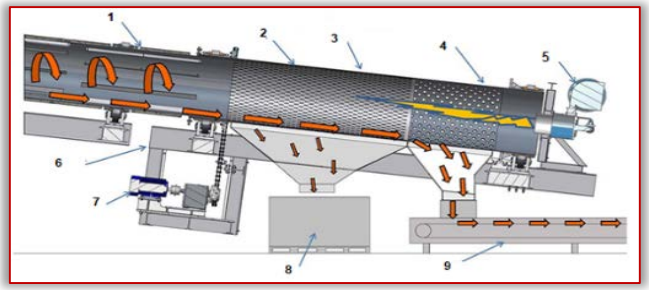


Figure 9 - Combined drying equipment to process granular material at industrial scale [16]

1-rotary dryer; 2-separation sieve (2 mm mesh); 3-rotary screen; 4-separation sieve (2-40 mm mesh); 5—heating chamber; 6-rotary screen support; 7-power engine of the rotary screen; 8- collector chamber; 9-Transport conveyor toward the packing and storage.

CONCLUSIONS

This survey has the purpose to present the technical state of seed dryers, that manly have the same working principle of the cereals ones, and their place in the marc capitalization technologies, a very appreciated by product in food and phytopharma industry due to their low harmful cholesterol, high content of mineral and antioxidants.

Here in presented technology has a modular structure and can integrate a large variety of performant equipment's, which can be harmonized and suited in an flexible technical processing flow that can be adjusted in accordance with seed (granular material) mechanical and physiologic characteristics, and also of mark state (humidity, seed concentration, marc components, etc.) that in many cases is processed in fresh state, right after it was exhausted from the grape pressing lines.

Another technical fact that can be observed, is the fact that drying equipment's have many constructive features that can be used in almost all processing conditions: on site, outdoors or on platforms, but also in the industrial halls. In almost all the cases presented on internet the marc processing lines are placed on open halls, especially when is processed the fresh marc, because the large marc quantity that the fermentation process is not finished and du this fact the working environment must be well ventilated.

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Note:

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Research and Development in Environmental Protection (INCDPM), in Bucharest, ROMANIA, between 01–03 November, 2018.

References

[1] Chiriță C., (2018), Potentialul de specializare inteligenta in domeniul Vitivinicol in regiunea Sud-Est, Seria "Rapoarte privind ecosistemele de inovare" (Intelligent specialization potential in viti-viniculture field in Sud-Est region, Series "Reports on Innovation Ecosystems") Published by UEFISCDI;

[2] Domínguez J., Martínez H., Lores M., (2016) Earthworms and Grape Marc Simultaneous Production of a High-Quality Biofertilizer and Bioactive Rich Seeds; Grape and Wine Biotechnology, Chapter 8, Inteh Publisher, DOI: 10.5772/64751;

[3] Ellen MacArthur Foundation. (2012), Towards the Circular Economy: an economic and business rationale for an accelerated transition. "Developing BS 8001 - a world first". The British Standards Institution. Retrieved 29 December 2017;

[4] Geissdoerfer M.; Savaget P.; Bocken N. M. P.; Hultink E.J., (2017). "The Circular Economy – A new sustainability paradigm?". Journal of Cleaner Production. **143**: 757–768, doi:10.1016/j.jclepro.2016.12.048;

[5] Milea D., Vișan A.L., Păun A., Bogdanof C.G., Ciupercă R, (2018), Technological and ecological aspects of some wine waste recycling and their capitalization in food industry, Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, vol. XLVIII/2018;

[6] Ponohaci Nicolai, (2002) Tuica si rachiurile naturale, Editura Ceres, Bucuresti;

[7] Milea D., Visan A.L, Prospective study regarding actual technology to recovery the viticulture by-products and the capitalization oportininities (Studiu prospectiv privind tehnologiile actuale de recuperare a produselor secundare din viticultură și modul lor de valorificare), phase 1 from project PN 18 30 02 01, made by INMA;

[8] https://www.westpromachinery.com/;

[9] http://economyindustrial.com/rotary-dryers.html.

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