ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 09, pp.38811-38814, September, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

VACUUMED-TYPE SILAGE PACKAGING PLANT AND SAMPLE DESIGN

***İlker Huseyin CELEN and Fulya TAN**

Department of Biosystem Engineering, Faculty of Agriculture, Namik Kemal University, Turkey

ARTICLE INFO

Article History:
Received 22nd June, 2016
Received in revised form
24th July, 2016
Accepted 07th August, 2016
Published online 30th September, 2016

Key words:

Vacuum,
Package,
Silage,
Machinery,
Feed.

ABSTRACT

Silage making technique is important. The main objective of the stack silage and bale silage making techniques are based on compression technology.In package silage technology, both vacuum and compression techniques can be used. Vacuum technology is based on the removal of air molecules from the environment. The package silage making techniques in recent years has found wide application area. In this research, vacuum type silage packaging system is planned in the central location. Regional data were analyzed with preliminary studies. Vacuum unit and the success of the system were examined. The most economical operating condition, was determined at 50 kg average package weight. Common use of machinery, ensuring quality forage and conducting similar studies are important for the sustainability of the livestock business.

Citation: İlker Huseyin CELEN and Fulya TAN, 2016. "Vacuumed-type silage packaging plant and sample design", *International Journal of Current Research*, 8, (09), 38811-38814.

INTRODUCTION

Shortage of high quality roughage and high costs of feed are at the top of the issues preventing small scale enterprise breeding from becoming sustainable. High quality of roughage and long storage period will contribute to the solution of this issue in general. Due to technological deficiencies, silage feeds produced using traditional methods cannot me ensiled in suitable conditions, compression cannot be made on necessary levels, decomposition starts with uncovering the silage, and thus, the nutritional content rapidly decreases. In cases where spoilage is not noticed, health costs of animals which consume these feeds also increase. Therefore, some producers quit the production of feed plants for silage, while others prefer to obtain silage feeds from outside without even questioning the quality of the feed. The biggest problem of bale silages is the deformation of the bales due to perforation of the surrounding plastic (Toruk *et al.*,2009). While the necessary hardware to prevent damage of bales in bale silage machines of combined type, the experience of the operator using the equipment is just as important. The easiest measure to be taken against the issue of damage is to increase the amount of enwrapping. However, this is not popular for every business due to the idea that it requires higher costs. On the other hand, the fact that a large proportion of bale silage machines in operation in our country are of foreign origin, has also increased the dependence on foreign sources in usage of consumables. This results in the increase in feed prices (Kavalcıoğlu, 2008). There are generally two different technologies dominating the production of silage. The basis of the ensilage technique applied over soil or inside a silo in the traditional method is compression technology. The basis of the bale silage making technique, which is rapidly developing nowadays, is also compression technology. Rather than compression technology, vacuuming technology is preferred inpackaged silages. Vacuum technology is used nowadays in numerous areas. It has an intensive area of usage especially in food packaging. While it is known that shelf life of goods increase with vacuuming, it is very important for food safety. Usage of vacuum technology, which has gained this much importance in human nutrition, is rapidly spreading in the chain of animal nutrition. While vacuum technology has been put into application via mobile systems, making of packaged silage with fixed systems started. The most important issues in these systems are the adequacy of the vacuum capacity, duration of implementation, correct enwrapping, and mechanical-chemical properties of the plastics used (Toruk and Kayısoglu, 2008). When vacuumed silage packaging plant is planned as central plant of milking, it is seen that if will have a great contribution to the solution of the issue of roughage.

****Corresponding author: İlker Huseyin CELEN,***
Department of Biosystem Engineering, Faculty of Agriculture, Namik Kemal University, Turkey.

While the primary purpose of this study is to achieve high quality roughage production, it also aims to establish shared machine usage andproduction of silage feeds in a single center, increase product quality, achieve the acquisition of qualified silage feeds with long shelf lives, reduce the purchasing of machines by producers, pioneer the emergence of new lines of work for regional producers by enabling silage feeds to become bought and sold goods, and contribute to the social and cultural development in rural life.

MATERIALS AND METHODS

The study was carried out in the region with the coordinate's of41° 6' 58.8528" North and 27° 28' 21.6120" East near the province of Tekirdag. The region has an approximately 5000 decares of irrigable land. It was chosen because agriculture and breeding is continued on a large scale; it has an Agricultural Development Cooperative; the number of individuals in agriculture is high; it has logistics advantages; it is close to other neighborhoods and the province of Tekirdag, and the breeders do not have prejudices against new techniques. There are 178 farmers in plant production and 59 business owners in animal breeding. It was considered that 1800 farmers in plant production and 465 breeders in animal breeding may also utilize this facility. It was projected to establish an additional system to the procedure of milk collection and cooling in the shared center build in the scope of the Development Cooperative. Work was carried out to establish the vacuumed-type packaging facility. Vacuum technology is used in lengthening the shelf life of various foods used in human nutrition, and it is not a new technology. Introduction of the vacuuming technique where food safety is high in usage in animal feeds is a new subject. Vacuumed packages play an important role in our lives every day in terms of storing food in a hygienic way and preventing food waste. It is preferred for increasing shelf life in storage, safe shipping, protection from undesired smells, preserving appearance, preventing loss in the product, as well as preventing deformation and loss of properties.

Using silage packaging machines, feeds shredded for silage are transferred into bags and air molecules in the bags are removed from the environment using vacuum technology. The material in the package is then sealed and package silages are prepared. In addition to mobile machine systems used with this purpose, there are also models designed for stationary usage. In this study, the dimensions and weights of the packages were determined using pre-questionnaires based on the working capacity of the machine to be provided for shared usage of the village and the tools and equipment the producers have in their hands. Packaging times and packaging work success were determined based on package dimensions. Preliminary tests were conducted with the vacuum unit of the packaging facility. Different levels of vacuuming were tested. Packaging was done in three different levels as the control (K) where no vacuum was applied, an experiment where a vacuum of 4200 1/min was used (V1) and another where a vacuum of 8400 1/min was used (V2). Flieg scoring provides important clues regarding the quality of silage (Nauman and Bassler,1993). Therefore, the packages were opened after the 80-day storing period, DLG (smell, structure) (DLG, 1983) and Flieg scoring was carried out, and CFU values were recorded. The most suitable working system was determined based on the acquired results.

RESULTS

A total of 1,480 tones of feed plant for silage was produced in the selected region in the year 2014. Source of production of feed plants for silage and the amount of production are given in Table 1. While most of the production consists of corn, it is a low amount for the region. There are 574 registered cattle in the region. Calculating for 20 kg daily roughage, there is an annual need for 4,190,200 kg of feed. Total feed production is able to satisfy only 35.32% of the need. These are optimistic calculations assuming lossless production of these feeds. It is known that a large proportion of silage feeds produced with traditional methods is spoilt (due to compression issues, or problems such as uncovering in the process of feeding).

Table 1. Source of production of feed plants for silage and the amount of production (2014)

Source	Amount (tones)
Corn	600
Fodder peas	480
Alfalfa	400
Total	1.480

Various studies report that spoiling issues due to perforation in bale silages reach up to 10% (Kavalcıoğlu, 2008). Only 584 da of the region, which has 5000 da of agricultural land with potential of irritability, is being used for feed plant production. Broadening of the existing production areas was also projected in the case of realization of the silage packaging machine in the area with this purpose. Vacuum packaging was considered for the planned facility. The most important advantages of vacuum technology are obtaining high quality roughage with low loss in product and high nutrient amounts, and long storage life of feeds. Additionally, in the case of packaging via a central system, each producer will not have to buy the necessary tools and equipment to obtain roughage, will not experience stress over how to produce high quality feed, and will be able to resolve issues regarding obtaining high quality roughage by finding a common ground in shared used of the machine. Producers, who will find the opportunity to hold, store and sell their products with silage packaging, will start utilizing larger areas for feed plant production in the next year, and will have the position to gain additional profits by being able to solve problems of the surrounding regions. These intensive agricultural efforts may also be effective in encouraging the young population to stay in the region. Based on the profits of the product, it is seen that feed plant sowing areas will show a rapid increase. Therefore, breeding in the region will be in a position to resolve the issue of roughage with its own means. Everyone in the region works on breeding in the form of small family businesses. According to the data of the questionnaire used in the region, businesses involved in breeding have tool and machine deficiencies. Only one business has a pre-loading digger. Thus, the common demand was determined as an average of 50 kg for the packages produced in the facility.

The General State of the Plant

The schematic representation of the plant planned for an enclosed building is given in Figure 1. The product is transferred to the storage via the feedband (1). The product storage (2) is the section the material is firstly brought by agriculture carts or trucks. The material is transferred into the bag located on the conveyor belt (3). The material from the storage is poured on the sack/bag located on the weighing unit (4). Weight measurement is active using 4 weight sensors in the weighing unit and the feeding stops when the desired weight is achieved. Based on the distance between the location of the packages and the storage, there may be a ± difference among packages on the level of grams. After vacuuming (5) the packages on the conveyor belt, the openings of the bags are closed in the clipping unit (6) and the sacks are sealed in the sewing unit (7).The prepared packages are made suitable for stacking in terms of shape by running them through the compressing belt (8). Packages passing through the feedband (9) are loaded to the vehicle. The producer bringing the batch of material to the facility will be able to receive his packaged silages by going to the other side of the facility. The transmission system of the facility consists of three lines from the entrance to the exit: the transfer line from the storage where raw material is dropped to the feeding storage, the line where vacuuming takes place, and the output line for loading. Installed capacities and transmission speeds of the conveyor belts in the transmission system are given in Table 2.

The facility is operated by making a package weight selection (1-300 kg) on the PLC control unit with a main menu in Turkish. It was an interface with easy usage. Selections may be made manually or automatically. As the package size selection to be used in packaging was 50 kg, the operation of the facility was fixed to this mode. The system has an installed capacity of 13.5 kw. This capacity is the total power consumed by all units in the facility working at the same time. Units in the system are not operated at the same time. They are operated periodically. This provides an important advantage in reducing the consumption of power. Package weights and packaging times were measured in the packaging unit of the facility for green corn containing 38% dry matter. Sample packaging for the experiments was done in the sizes of 1,30,50,100 and 300 kg. Table 3 shows the times that elapsed to pack an average of 10 packages and the weights of the packages. Vacuumed-type silage packaging plant consists;

- Feeding band (1),
- Storage (2),
- Conveyor (3),
- Weighting unit (4),
- Vacumming unit (5),
- Clipping unit (6),
- Sewing unit(7),
- Compressing band (8),
- Loaded band (9) ve
- PLC control unit (10)

(Dimensions: W:4000 mm; Long:25000 mm; Height:3478 mm)

Figure 1. The schematic representation of the facility planned for an enclosed building

Table 2. Installed capacities and transmission speeds of the conveyor belts in the transmission system

	Feeding band	Package band	Compressing band	Output line for loading band
Drive unit (mm drum)	217	113 (1/2)	113	87
Power (kw)	2,2	2,2	2,2	0,75
Transmission speed (m sn^{-1})	0,647	0,065	0,130	0,136

Table 3. The times that elapsed to pack an average of 10 packages and the weights of the packages

The expected packed weight (kg)	Packed weight (kg)	Weight sensitivity (g)	The average duration of packaging (s)	Work succes (t/h)	Work succes (package/h)
1	1,16	+ 160	8	0,45	450
30	30,10	+ 100	12	9	300
50	50,08	+ 80	15	12	240
100	100,07	+ 70	22	16,36	163
300	300,05	+ 50	28	38,57	128

Table 4. Results regarding the implementation of vacuum, DLG and Flieg scores determined after opening and CFU values

Application	DLG *	Quality classify	Fileg **	Quality classify	CFU g^{-1}
K	1	B	19.3	B	$10,8x10^4$
V1	5	M	39.8	M	0,0
V2	17	Ex	95.5	Ex	0,0

*DLG-16-20,(Ex) Excellent;10-15,(F) Fair;5-9,(M) Medium;0-4,(B) Bad

**FLİEG 0-20,(B) Bad; 21-40,(M) Medium;41-60,(F) Fair;61-80,(G) Good; 81-100 (Ex) Excellent

The choice regarding the packaging cost, working of the facility, and transferring and storing packages was determined as 50 kg. In case of packaging 50 kg of content, the packaging unit is able to produce 12 tons of products in an hour as packaged silage. The most important implementation in making vacuumed silage is to know the suitable vacuum level. Preliminary tests were conducted with the vacuum unit in the system. Results regarding the implementation of vacuum, DLG and Flieg scores determined after opening and CFU values are given in Table 4. The quality of packaged silages was found suitable in the experiment situation of V2. These results show the importance of the adequacy of the level of vacuum for the quality of silage. High quality packaged silages may be obtained with packaging costs only. Cooperative mobility will be achieved by the initiation of the facility, and solidarity among producers will increase. They will be able to gain additional profits by running the facility for surrounding regions in times it is not busy.

Conclusion

Making 50 kg bags of silage provided the most suitable results in vacuumed-type packaged silages for the region. While the packaging costs are also economically affordable, mechanization applications are easier in the stages of transferring and storing the bags. The facility has a capacity to make a 300 kg package, and it may provide different types of usage when needed. The level of vacuum applied is important in terms of the quality of the feed. Therefore, the system should be used with the recommended vacuum levels. It becomes possible to obtain high quality roughage with long storage life by correct usage of vacuum technology. Possible loss of product and nutrition may be minimized.

The fact that it makes packaging in variable sizes based on business conditions possible, also provides an important advantage in terms of providing producers with the choice over package sizes within their own means of mechanization. As the facilities that may be established in this way are central, they make shared usage of machines possible. While this has numerous advantages regarding the development of the rural population, it is also projected that it will be a significant solution for breeding in the region as it provides encouragement to take part in wider agricultural activities in feed plant production.

REFERENCES

DLG, 1987. Bewertung von grünfutter, silage und heu merkblatt 224. DLG-Verlag;1987

Kavalcıoğlu, S. 2008. Yonca balya silajında parça boyu, plastik rengi ve sarma katının silaj yem kalitesine etkisi" Namık Kemal Üniversitesi Fen Bilimleri Enstitüsü Tarım Makinaları Anabilim Dalı, Yüksek Lisans Tezi, Tekirdağ.

Nauman, C., Bassler, R. 1993. Die chemische untersuchung von futtermittein. method enbuch, band III. VDLUFA-Verlag, Darmstadt.

Toruk, F., Gönülol, E., Ulger, P. 2009. Color changes of bale silage under different storage conditions. *Journal of Agricultural Machinery Science*, Vol:5 (2), 211-216, İzmir.

Toruk, F., Kayişoğlu, B. 2008. Effect of applied vacuum of silage package machine on silage quality. *Tarım Makinaları Dergisi*, 4(4), 355-360.

****