Monitoring of the input-output operations in cows milking parlors Parallel type with a capacity of 2x24

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Abstract

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The aim of the present study is to analyze the input-output traffic and the actual throughput of a „Parallel" type milking parlor with a capacity of 2x24.

Studies were performed during the period April - May 2020 in the cow farm located in the Republic of Bulgaria, Chirpan municipality. Its capacity is about 600 cows (with a tendency to increase the herd) of which 453 are milked. They are reared freely in groups on a deep non-removable bedding (manure with a minimum amount of straw) with daily milling. Milking is performed in a „Parallel" type milking parlor with a capacity of 2x24, „quick exit" and double milking per day.

The experimental research was carried out through the video surveillance information system installed on the farm, which includes 18 cameras, a recorder, a hard disk, a UPS, a power supply unit and a router.

The production process in and around the milking parlor was monitored. The duration of the input-output traffic is timed and its influence on the total hourly productivity of the milking installation is established.

In the course of the research it was established what part of the input-output operations (entirely dependent on the animals) of the total time for the whole milking process including entering the cows, washing, drying, placing the miking units, actual milking, sealing and leaving the cows from the platforms. The statement is proved that in compliance with the normative requirements and the correspondence with the good world practices in the design of milking parlors (of the considered type) with their adjoining waiting rooms and passes about 2/3 of the total milking time depends on the animals and about 1/3 from the milkers.

Keywords: milking parlors; planning parameters; technological conditions

Introduction

In recent years a number of free-stall farms have been built around the world. The design of each of them is a unique process influenced by factors such as built infrastructure, animal movement options and last but not least the preferences of investors.

It is essential in the conceptual design to choose a suitable milking parlor for the farm taking into account the influence of local conditions, management of milking cows, farm capacity and more.

Milking parlors guarantee high productivity, good hygiene in the production process, welfare and low-stress care of animals, ergonomic working conditions for staff (Uzunova et al., 2021; Jakob, 2019). All this can be achieved provided that a suitable milking parlor is selected for the farm, the milkerrs are highly qualified, adequately operate the milking equipment and analyze the data from the automated systems for monitoring the physiological condition and health status of animals (Georgiev, 2021).

The time for the actual machine milking varies from 4–11 min but according to Dineva (2014) the same can be reduced to some extent by increasing the pulsation rate. It is more important that animals with different lengths of milking time are grouped separately (Georgiev, 2016; Reinemann, 2019). According to Spasov et al. (1990) the duration of complete milking depends mainly on the animals and the time for which they will enter and leave the milking places.

In practice the emphasis is entirely on the time for the actual milking of the animals and the time for the input-output operations is not taken into account.

According to a number of authors, the design of the milking machines in a suitable way significantly improves the capacity of the respective milking parlor, which in turn reduces the total milking time and increases the hourly productivity (Armstrong, 2001; Barry, 1992).

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In order to optimize the input-output traffic some authors recommend specific types of passes to and from the milking parlor with the required widths and lengths and the relationship between them. According to Welchert (1992) there should be no bends greater than 45° in the corridors. Georgiev (2021) recommended that the width of the corridors should not be less than 90 cm in straight sections and in bends they should be widened to 160-170 cm. Georgiev (2016) proves that the formation of a 180˚ turn immediately after the milking platforms significantly increases the time for the animals to leave the milking parlors. At the same time the author recommends installing a tight (opaque) barrier to the exit doors of the milking platforms as the visual contact between the animals leaving the milking parlor and those who are still milking increases the time for exit traffic and slows down the entrance of the next group to the milking platform.

In order to better manage the herd in most of the milk production farms at the exit of the milking parlor is installed a selection door the purpose of which is to divide the animals according to their health or physiological status (Gordeev et al., 2018; Gordeev et al., 2019). The selection door is an element of the overall technology associated with milking and has a direct impact on the time it takes for cows to leave the areas after milking (Carlsson, 2009). In this regard, Georgiev (2016) recommends in the milking parlors equipped with selection doors to build a buffer zone (second waiting room) between the milking platform and the entrance of the selection door.

The aim of the present study is to analyze the input-output traffic and the actual throughput of a „Parallel" type milking parlor with a capacity of 2x24.

To achieve this goal the following tasks are set:

- Monitoring of the production process in and around the milking parlor through the existing in the site information monitoring system (in real time).

- Timing the duration of the input-output traffic and establishing its influence on the total hourly productivity of the milking installation.

Material and Methods

The object of the study is a „Parallel" type milking parlor with a capacity of 2x24.

The subject of the study is the behavioral reactions of the cows in the passes around the milking parlor and the time of the input-output operations related to the milking process.

Studies were performed during the period April - May 2020 in the cow farm located in the Republic of Bulgaria, Chirpan municipality. Its capacity is about 600 cows (with a tendency to increase the herd) of which 453 are milked. They are reared freely in groups on a deep non-removable bedding (manure with a minimum amount of straw) with daily milling. Milking is performed in a „Parallel" type milking parlor with a capacity of 2x24, „quick exit" and double milking per day. The level of automation of the milking equipment includes: automatic removal of the milking units, automatic system for electronic identification of the animals, automated system for detection of heat, movement activity and activity of ruminal and individual electronic milk meters. The two exits of the milking parlor are equipped with selection doors. The management of all subsystems is performed by a specialized software product for electronic management of the herd. In front of the milking parlor there is a separate waiting room for non-milked animals with a capacity of 100 cows. In order to implement the „quick exit" a buffer zone is provided between the milking parlors and the selection doors (Figure 1).
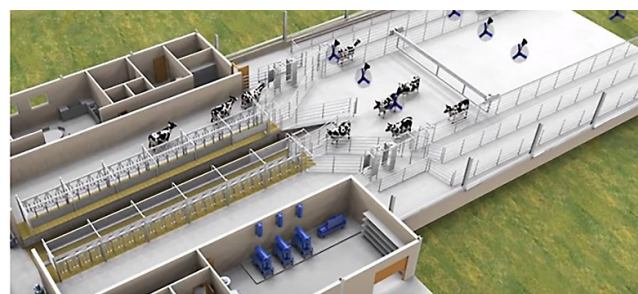
Fig. 1. General view of the milking parlor of the monitored site with its adjoining passes and selection doors

The experimental studies were performed using the farm's existing surveillance information system, which includes 18 CCTV cameras, a recorder, a hard disk, a UPS, a power supply and a router.

The results of the performed calculations are interpreted in analytical, tabular and graphical form. The comparative-analytical method is used in the research.

Results and Discussion

During the observations, the times for entering and exiting the cows in the platforms and their movement in the passes around the milking parlor were timed. The animals enter each of the milking platforms through pneumatically opening sliding doors. The first cow moves to the end of the platform and activates a side divider which fixes the next animal (Figure 2).

Fig. 2. Lateral divider between animals

The action is repeated successively by each subsequent cow and this ensures the positioning of the cows on the milking platforms and excludes the possibility of an incoming cow to occupy any of the middle places.

Table 1 shows the times of entry (loading) of cows in a platform from the milking parlor. They range from 146 s to 206 s (average 174 s) with no significant difference in times for the left and right platforms.

The waiting room in front of the milking parlor has a mechanical feeder which is not used constantly and is often replaced by an operator directing the cows to the milking parlors (Table 2). The average entry time is 189 s which is about 10% more than the entry by driving with a mechanical undercarriage. The results correspond to the statement of Grandin (2014) that the movement of people and the noise around the milking parlors generate additional stress in the animals. This in turn slows down the positioning of the animals and adversely affects the overall process of milking the cows.

The time for the actual milking of all cows from one platform varies from 634 s (10 min 20 s) to 897 s (14 min 57 s) ie. average 766 s (12 min 59 s).

The presence of slower milking animals is observed on both platforms which leads to the retention of the caws from the whole platform, slows down the overall milking process and reduces the hourly productivity of the milking mparlor. This requires the animals to be grouped according to the „milking speed" factor of the animals. In the Material and Method section it is described that the milking parlor has a „quick exit" and after it there is a buffer zone (second waiting room). The length of the same is equal to that of the milking platform and its width is 610 cm. The time for the cows to leave the milking parlors varies from 22 s to 42 s (average 31 s) and the departure time from the buffer zones (second waiting rooms) averages 114 s (Table 4).

Table 1. The time for loading a platform with dairy animals by means of a mechanical subcarrier, s

Number of observation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average
Loading a platform	189	176	168	159	186	181	178	167	158	170	169	175	174	206	146	172	168	191	177	165	174

Table 2. The loading time of a platform with milking animals with operator guidance, s

Number of observation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average
Loading a platform	176	196	187	199	146	188	187	193	178	206	176	195	174	216	187	199	201	191	186	192	189

Table 3. The milking time of all cows from one platform, s

Number of observation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average
Time for actual milking of all cows from the platform	678	774	857	760	834	772	735	710	825	750	745	761	695	801	897	745	835	761	794	844	779

Table 4. Exit of cows from the milking platform and release of the buffer zone after the milking places, s

Number of observation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average
Exit platform	31	33	34	28	33	31	31	29	24	30	37	22	26	39	30	29	42	38	21	25	31
Buffer zone release	139	97	112	126	131	99	107	103	121	114	101	118	123	103	109	116	111	121	103	116	114

The experiments revealed that there were no factors delaying the progress of the cows from the milking parlors.

In the course of the performed tests, the operations accompanying milking, washing, drying, placement of the milking unit and disinfection of the udder after milking the cows were also observed (Table 5).

Table 5. The time of the accompanying operations in the milking process for all cows from one platform, s

Operation	Washing and drying	Placing milking unit	Disinfection
Average time	248	163	119

The time for washing and drying the udder of animals is about 250 s which is almost twice as long as for disinfection (119 s). The placing of the milking units takes about 165 s to a large extent depends on the work of the milkers and their qualification. In the event of a reorganization of the milking production process the duration of the accompanying operations may be reduced to a small extent.

Conclusions

A comparison of the results shows that with the largest share of time for complete milking nearly 51% (50.7%) is related to the actual extraction of milk and the smallest for the release of cows from the platforms (2%) and release of the second waiting (7%). Accordingly, the filling of a platform with cows takes an average of 180 s (about 11%), their washing and drying is 248 s (17%) and the placement of the milking units is 163 s (12%). With the correct design of a „Parallel" type milking parlor with its adjoining waiting rooms 71% of the total milking time depends on the animals (20% of it takes input-output operations) and 29% of the milkers.

Recommendations: It is necessary in the conceptual design of the farm to choose a suitable milking parlor for the farm, to carefully consider the impact of local conditions and in an appropriate way to design the passes and waiting rooms to the milking parlor. It is very important and last but not least that the milkers working in the milking parlor are highly qualified, to adequately operate the milking equipment and to analyze the data from the automated milking systems.

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