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## Automatic milking systems and their chances in the Czech Republic

*J. Vegrícht*

*Research Institute of Agricultural Engineering, Drnovská 507,  
161 01 Praha , Czech republic  
E-mail: vuzt1.05@bon.cz*

Two stables for 300 dairy cows were compared in model, one with milking in herringbone milking parlour 2 x 12 with rapid exit and automated data collection and the second equipped for milking by two AMS LEONARDO. The costs of stable with milking in milking parlour including milking parlour and milk store room are by 7% higher than similar costs for stable with milking in AMS. In contrast to this the costs for technical equipment of stable are by 185% higher in stable with milking in AMS than those in stable with milking parlour. The highest share of the increased costs represents the AMS price, which is by 361% higher than price of milking parlour. Total investment costs of stable for 300 dairy cows with milking in AMS are by 17.35 mil. CZK (i.e. by 62.6%) higher than those of stable with milking parlour. These costs are then shown in total operational costs of stable and costs per production of 1 litre of milk so that total annual costs on farm for 300 dairy cows with milking in AMS are under similar conditions by 9.9% higher in comparison with identical farm but with milking in milking parlour. In comparison of the both milking systems is necessary to take into account, that at 3-time daily frequency of milking there was reached same effect of milk yield increase as at voluntary milking in AMS. A certain problem seems to be deterioration of reproduction parameters in consequence of milking increased frequency. Due to change into 3-time daily milking the conception has deteriorated (insemination index has increased by 0.4), the interval has extended by 18.1 days and service period has increased by 6.3 days.

**Key words:** *Robotic milking, parlour milking, production costs.*

In the 90's was finished the basic development of AMS (Automatic Milking System) and now it is rapidly extending within European farms for dairy cows keeping. It concerns mainly the farms with relative low number of dairy cows. On the Czech farms is normally kept 200 – 800 dairy cows.

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### Summary

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### Introduction

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This farm size has considerable problems when using current AMS. These problems have to be analysed in details (Vegricht, 1999). It regards particularly:

- Constructional and disposal design of current stables in relation to the AMS demands and real possibilities of their reconstruction.
- AMS performance with respect to total number of dairy cows in one stable and on farm.
- Dairy cows milk yield and possible benefits resulting from change to AMS milking.
- AMS benefits in social sphere on dairy farms in CR.
- Economical aspects of AMS utilisation in comparison with milking in milking parlour.

The real performance of current AMS is for single – box system max. 60 dairy cows and for multi – box system max. 150 dairy cows per day (Schön, 2000). In larger stables and on large - size farms it calls for installation of some AMS to reach total output corresponding with number of housed dairy cows. With respect to requirements on dairy cows free movement to AMS, to feeding place and to box bed it seems that the most simple and the cheapest solution for application of this milking system will be construction of new, light stable providing AMS requirements for size and constructional and disposition solution (Vegricht, 2000).

The average milk yield of dairy cows in CR in 2 000 has reached about 5 300 l. Considering the lowest limit of milk yield for AMS application 8 000 l/year which is a condition for achievement of milk yield increase in consequence of multiple milking, this system application may be thing over for about 10% of dairy cows in CR. The similar effect can be reached for parlour milking as found out e.g. during experiments carried – out by Dolezal (Table 1), who found the milk yield increase by about 18.9% when milking process has changed to 3 – time daily. The contributions obtained by milk yield increase have to balance the wages, energy and feedstuffs costs increase, deteriorated reproduction indicators, increased wear of milking apparatus, disinfections etc. A certain problem seems to be deterioration of reproduction parameters in consequence of milking increased frequency. Due to change into 3-time daily milking the conception has deteriorated (insemination index has increased by 0.4), the interval has extended by 18.1 days and service period has increased by 6.3 days (Dolezal, 1999).

The social benefit of the AMS milking application is not so expressive under conditions of larger farms with shift work character compared with family “single – man” farms. Higher amount of workers on farm enables to maintain adequate working time and change of workers enabling them to have a free time in regular intervals. Just this aspect of AMS application (elimination of energy day presence of farmer at morning and evening hours in stable during milking) is in many cases decisive for AMS purchase on small dairy farms. The milk production economy is on the Czech farms

the most important criterion for all investment decisions. Conditions of the Czech farmers are at present considerably different from situation of farmers in the EU countries. For example, when the single – box AMS price will be expressed by amount of milk which the Czech has to sell compared with e. g. German farmer, than at this AMS price 300 000 DEM and milk realisation price 0.60 DEM/l and 7.50 CZK/l and currency rate 18.50 CZK/DEM the German farmer has to sell 500 000 litre of milk, but Czech farmer 740 000 litre, i. e. by 48% more.

For purposes how to determine economical aspects of AMS utilisation for milking on large farms corresponding with needs and requirements of the Czech Republic there were compared in model two stables for 300 dairy cows of which one was equipped for milking by herring – bone parlour 2 x 12 with rapid exit and automated data collection and the second stable equipped by two AMS LEONARDO, of which each has 4 milking stalls and 1 preparation box.

The ground plan scheme of these stables is shown in figure 1 and 2. In this connection is necessary to emphasise the model character of these stables design, where e.g. stable with AMS is extremely long. Therefore before eventual realisation it would be suitable to solve many details and to cooperate with the AMS manufacturer. For this study purposes this design is quite sufficient.

For these stables were determined in model the necessary investment costs and computed costs per 1 litre of milk production. The calculation was based on the basic milk yield 9 000 litre per 1 cow and year. In consequence of the milking increased frequency using AMS it is presumed to increase milk yield by 15% to 10 350 l per cow and year. Because according to experiences the same effect can be reached at milking 3-time daily in milking parlour, the calculation was completed also by this case, i.e. milk yield increase to 10 350 l at 3 – time daily milking on farm with herring – bone milking parlour 2 x 12.

In the calculation was involved as well saving of one milker for AMS milking in comparison with parlour milking, because recent experiences show that even milking system in AMS needs certain man activity.

In table 2 are presented investment costs and their composition in stable for 300 dairy cows with parlour milking (Figure. 1) and in table 3 are presented similar costs for stable with milking in AMS (Figure. 2)

The construction costs per stable with parlour milking including parlour and milk room store are by 7% higher than those per milking in AMS. This can be explained by milk store room situated in stable and by absence of dairy cows gathering place before milking in stable with milking in AMS.

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## Methods

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## Results and discussion

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Table 1. Effect of milk yield change during standardised lactation (Dolezal, 1999).

| Group | Number of finished lactations | Unit | Milking frequency in one day |             | Change % |
|-------|-------------------------------|------|------------------------------|-------------|----------|
|       |                               |      | 2x                           | 3x          |          |
| A     | 148                           | kg   | 5 422 ± 720                  | 5 498 ± 595 | 1.4      |
| B     | 102                           | kg   | 6 228 ± 782                  | 6 776 ± 801 | 8.8      |
| C     | 48                            | kg   | 7 122 ± 788                  | 8 468 ± 922 | 18.9     |

In contrast with this, the costs per stable technical equipment are for stable with milking in AMS by 185% higher than for stable with milking parlour. The highest share of increased costs has the AMS price, which is by 361% higher than the milking parlour price. Total investment costs per stable for 300 dairy cows with milking in AMS are by 17.35 mil. CZK (i.e. by 62.6%) higher than, those for stable with milking parlour.

These costs will appear in total operational costs of stable and production of 1 litre of milk presented in table 4. Total annual costs on farm for 300 dairy cows with milking in AMS are under almost identical conditions by 9.9% higher compared with similar farm with parlour milking. Comparison

Table 2. Investment costs per stable for 300 dairy cows with milking in herring; bone parlour 2 x 12 with rapid exit, 10<sup>3</sup> CZK.

| Item  | Description   | Investment costs |
|---|---|------------------|
| Stable construction   | 6 –row stable with central feeding corridor and number of feeding places at trough 1:1.5, ground plan 32 x 72 m | 9 216            |
| Milking parlour with milk store room                        | Herring – bone milking parlour with 2 x 12 milking stalls and waiting room (1.5m <sup>2</sup> /cow)             | 4 976            |
| Slurry and waste water reservoir                            | Storage capacity 6 months, 3 500 m <sup>3</sup>   | 3 500            |
| Construction costs in total                                 |   | 17 692           |
| Internal equipment of stable                                | Fence, drinking, mattress   | 1 800            |
| Manure removal  | 2 x 2 scrapers  | 1 000            |
| Milking parlour   | Herring (bone 2 x 12 with rapid exit, milk flow) meters, pedometer, PC, fence, el. driver                       | 4 910            |
| Milk cooling and storage                                    | 2 cooling tanks, 2 x 6 500 l, recuperation  | 1 200            |
| Feeding   | Feeding wagon with auger, 12 m <sup>3</sup>   | 1 100            |
| Total technology costs                                      |   | 10 010           |
| Total investment costs                                      |   | 27 702           |
| Total investment costs over – calculated to 1 housing stall |   | 92.34            |

Table 3. Investment costs of stable for 300 dairy cows with milking in 2x AMS LEONARDO, 10<sup>3</sup> CZK.

| Item  | Description   | Investment costs |
|---|---|------------------|
| Stable construction   | 4 – row stable with 2x AMS Leonardo, feeding stall situated laterally, ratio of feeding places at through 1:2, ground plan 22 x 124.8 m | 11 704           |
| Milk store room   | Storage capacity 13 000 l   | 1 326            |
| Slurry and waste water reservoir                            | Storage capacity 6 months, 3 500 m <sup>3</sup>   | 3 500            |
| Construction costs in total                                 |   | 16 530           |
| Internal equipment of stable                                | Fence, drinking, mattress   | 1 800            |
| Manure removal  | 2 x 2 + 2 scrapers  | 1 800            |
| Milking   | 2 x AMS Leonardo, each 4 + 1 box, pedometers  | 22 620           |
| Milk cooling and storage                                    | 2 cooling tanks with recuperation, 2 x 6 500 l  | 1 200            |
| Feeding   | Mixing feeding wagon with auger, 12 m <sup>3</sup>  | 1 100            |
| Total technology costs                                      |   | 28 520           |
| Total investment costs                                      |   | 45 050           |
| Total investment costs over – calculated to 1 housing stall |   | 150.17           |

of the both systems needs to take into account that the 3 – time daily frequency of milking allowed to reach the same effect of milk yield increase as in voluntary milking in AMS.

A certain problem seems to be the reproduction parameters deterioration in consequence of increased milking frequency. During tests in VÚ•V (Dolezal, 1999) the conception has deteriorated with change to the 3 – time daily milking (insemination index has increased by 0.4), the interval has extended by 18.1 days and service period has increased by 6.3 days. Explanation of these problems will need priority attention.

In connection with the AMS also development of partial milking devices was significantly sophisticated, particularly the automated monitoring of mammary gland health status and milk quality. This has a positive effect on technical level improvement of other milking devices.

For stables with higher number of animals will be purposeful to focus the next development to the multi-box systems of AMS with arrangement of milking stalls, e. g. within the circle perimeter enabling to reach better animals passage.

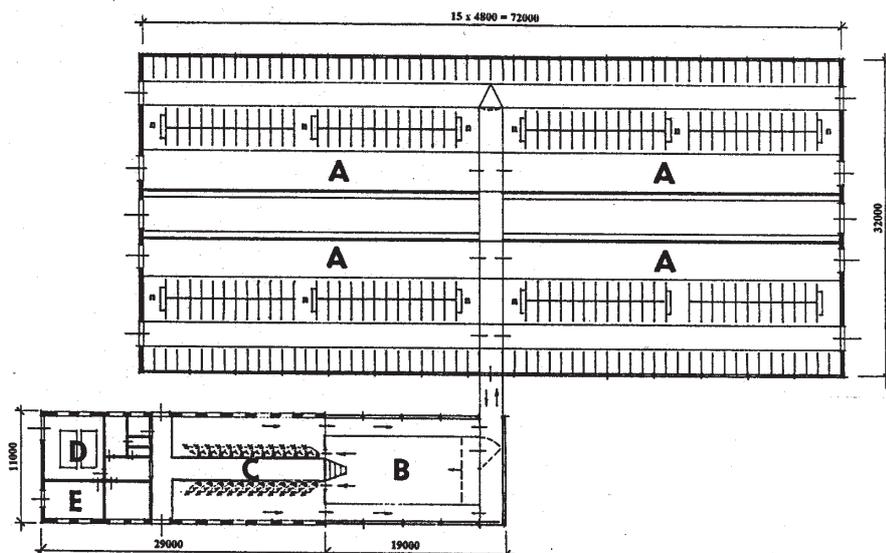


Figure 1. Stable for 300 dairy cows and herringbone parlour milking with rapid exit:

- A- stable part for 150 cows,
- B- dairy cows gathering places before milking,
- C- milking parlour 2x12,
- D- milk store room 2 x 6500 l,
- n- watering place

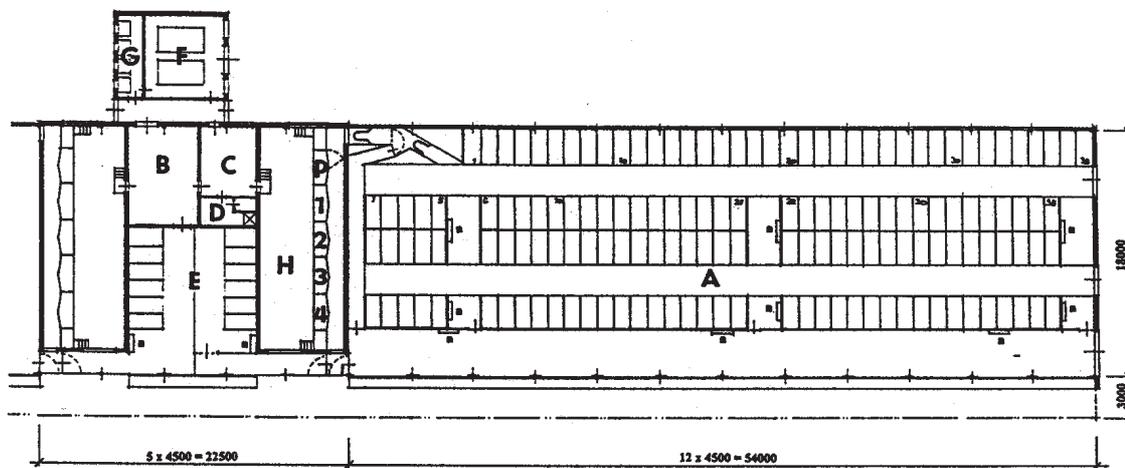


Figure 2. Stable for 300 dairy cows with milking in AMS Leonardo:

- A- stable part for 150 cows,
- B- machine room,
- C- office room,
- D- washing room WC,
- E- pens for trouble cows,
- F- milk store room 2 x 6500 l,
- G- cooling aggregates,
- H- AMS Leonardo,
- P- preparation box,
- n- watering place

It also would be useful to reduce the time for AMS milking apparatus application as one of presumption to increase their performance and better utilisation of robotized arm what will bring relative price cut down of 1 milking process.

On the large – size farms the positive contributions can be considered in the replacement of milker tiresome work and introduction of milking standard quality and milk high quality without human factor.

The basic condition for AMS application will be economy, i. e. AMS effect on the milk production costs and its realisation price. It considers mainly the high purchase price of AMS, which is so far the invincible obstacle for the Czech farmer. Therefore in near future we do not expect application of this milking method in conditions of Czech farms.

This contribution is based on results of the NAZV projects solution with financial support of the Czech Ministry of Agriculture, No. QD 0176 and of the research intention MEZM 05-9901

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