

**Vadim O. KITIKOV, Eugene V. TERNOV**

The Republican Unitary Enterprise "Scientific and practical centre of the National academy of sciences of Belarus of agriculture mechanization"

1, Khnorina str., 220049. Minsk, Belarus

e-mail: [ternov@tut.by](mailto:ternov@tut.by)

## **TECHNICAL AND ECONOMIC COMPARISON OF CATTLE DAIRY MANAGEMENT SYSTEMS BASED ON RADIO-FREQUENCY AND INFRA-RED IDENTIFICATION**

### *Summary*

*Automated dairy management systems (DMS) for cattle herd on commercial farms and complexes of yard housing now are an integral part of the "know-how" of milk production technology. All known DMSs use radio-frequency (RF) or infra-red (IR) method of animal identification. In development of the software of automated workplace of a livestock specialist at DMS the relative density of functions of data exchange with the technological equipment makes 40-50 %. By virtue of close communication with the system of automation of milking created on the basis of concrete means of automatics and high labor input of the development it has information compatibility only with strictly certain set of the equipment of milking automation. Thus its information functions regarding management of dairy (reports, statistics, registration of all kinds) do not depend on the external equipment and as a whole coincide for DMS-IR and DMS-RF. Thereby, it is reasonable to make the comparison of functionalities of DMS mainly with reference to the features basic means of automatics being used.*

**В.О. КИТИКОВ, Е.В. ТЕРНОВ**

Республиканское унитарное предприятие «Научно-практический центр Национальной академии наук Беларуси по механизации сельского хозяйства»

220049 Минск, ул. Кнорина, 1, Республика Беларусь

e-mail: [ternov@tut.by](mailto:ternov@tut.by)

## **ТЕХНИКО-ЭКОНОМИЧЕСКОЕ СРАВНЕНИЕ СИСТЕМ УПРАВЛЕНИЯ СТАДОМ КРС НА БАЗЕ РАДИОЧАСТОТНОЙ И ИНФРАКРАСНОЙ ИДЕНТИФИКАЦИИ**

### *Резюме*

*Автоматизированные системы управления стадом (СУС) КРС на молочно-товарных фермах и комплексах беспривязного содержания в настоящее время являются неотъемлемой частью технологии производства молока. Все известные СУС используют радиочастотный (РЧ) либо инфракрасный (ИК) способ идентификации животных. В разработке программного обеспечения АРМ зоотехника СУС удельный вес функций обмена данными с технологическим оборудованием составляет 40-50 %. В силу тесной связи с системой автоматизации доения, созданной на базе конкретных технических средств автоматизации, и высокой трудоёмкости разработки оно имеет информационную совместимость только со строго определённым комплектом оборудования автоматизации доения. При этом его информационные функции в части управления стадом (отчёты, статистика, учёт всех видов) не зависят от внешнего оборудования и в целом совпадают для СУС-ИК и СУС-РЧ. Таким образом, представляется целесообразным провести сравнение функциональных возможностей СУС главным образом применительно к особенностям используемых базовых технических средств автоматизации.*

### **1. Introduction**

Comparative characteristics of DMS-IR and DMS-RF equipment for configuration of the milking parlour using the example of "Milkline" Company solutions (Italy) are presented in table 1.

As a result of the analysis of the provided characteristics it is possible to note the following:

- IR-transponder is made as a multipurpose device and it is put only on collar for the most reliable fastening on trunk of an animal; a single information receiver is compatible with various types of IR-transponders;
- DMS-IR in comparison with DMS-RF measures more parameters of motion activity of an animal and more precisely reveals approach of estruation;
- DMS-IR surpasses DMS-RF in functionalities regarding gathering and analysis of data on digestive (chewing) activity of an animal;

- The pulsators used by both systems do not depend on the way of identification of animals and represent independent unified devices;
- The element base of IR-technology is applied not only to identification, but also to remote control of the unified means of automatics; this makes the unified means of automatics more compact and simple in using the individual mode of milking;
- □□-technology of definition of the dairy stream rate and the structure of milk is being developed in parallel with contactless transfer of information for some distance, makes the flow meters and identifiers of mastitis more compact and technological and increases the degree of unification of the element base and DMS equipment.

On the basis of components of each system DMS-IR and DMS-RF the variants comparable in structure of basic functions can be generated for carrying out of economic comparison.

Table 1. Characteristics of DMS-IR and DMS-RF

Technical characteristics	DMS-IR	DMS-RF
Cow identification	Fastening the transponder only on collar; reading on each workplace of the milking parlor. The advantage is the reliability of reading (not less than 95 %)	Fastening the transponder only on collar, leg, ear; implantation of the transponder into scar, lip or under skin; reading at the parlor entrance
Definition of motion activity of the animal (estruation reveal)	Upon movements of neck, head, trunk; single transponder for identification and definition of estruation Advantage: increased accuracy of estruation reveal according to complex measurements	Upon single-step activity of the cow; as a rule, separate RF-transponders for identification and transfer of single-step activity (pedometers)
Definition of rumination of the animal	A single transponder for identification, definition of motion and rumination	Not available Fastening transponders on a collar, a leg{foot}, an ear; implantation transponders in pybeu, a lip or under a leather{skin}; reading at an input{entrance} in a milking parlor
Control of milking at workplace	A single button on the stationary board, all adjustment are made from the remote control (one per milking parlor)	Many buttons on the stationary board or availability of a separate stationary controller for adjustment in the milking parlor additionally operated from computer
Individual mode of pulsation at workplace	Unified multimode programmed pulsator	Unified multimode programmed pulsator
Reveal of mastitis	IR, by electroconductivity	By electroconductivity
Software for dairy management	Basically repeats DMS-RF functions; it is more dynamically updated alongside with the additional equipment for its promotion in the market; it is unified for any type of milking parlor	Registration and analysis of milk yield, manual input of events, management of separation from dairy, tabular and graphic reports on milk production; preparation of data for breeding and animal technician works with dairy; control of stations of feeding; possible integration with calves feeding stations
Additional equipment	Stations of individual feeding and weighing, system of separation from dairy; a collective board in a milking parlor, signal lights of condition of the sides of milking parlor	Stations of individual feeding and weighing, system of separation from dairy

Table 2. Cost of the hardware for DMS equipping

Symbol	Name of the equipment	Cost, Euro
A	The basic set of the metalware of the milking machine «Parallel 2x16»	55687,00
B1	Complete set of equipment for control of milking on the basis of IR-identification ED200 with infra-red flow meters <sup>1</sup>	30271,00
B2	Complete set of equipment for control of milking on the basis of IR-identification ED200 with weight flow meters MEL1000 (ED200 + MEL1000) <sup>1</sup>	37232,00
C	Complete set of DMS-IR MilkonHM for ED200 <sup>1</sup>	16191,00
C1	IR-transponder with definition of motion activity <sup>2</sup>	70,00
C2	IR-transponder with definition of motion and digestive (chewing) activity <sup>2</sup>	97,00
C3	Standard 2-pass separating gate for ED200 (IR)	4005,00
D	Complete set of DMS-RF with definition of motion activity on the basis of RF-identification of Milpro2 ACTO+MPD <sup>1</sup>	49102,00
D1	RF-transponder with collar for fastening on the neck of an animal <sup>2</sup>	28,50
D2	RF-transponder for fastening on the ear of an animal <sup>2</sup>	12,50
D3	RF-transponder for implantation into the body of an animal <sup>2</sup>	3,00
D4	Reader of implanted RF-transponders <sup>3</sup>	813,00
D5	Standard 2-pass separating gate for Milpro2 ACTO+MPD (RF)	5866,00
E1	Pedometer for Milpro2 ACTO+MPD (RF) <sup>2</sup>	56,00
E2	Gate for reading the indications of the pedometers for Milpro2 ACTO+MPD (RF) <sup>3</sup>	5444,00
F1	Complete set of the equipment of the control of milking MPD New+Prog included into Milpro2 ACTO+MPD (RF) <sup>1</sup>	13319,00
F2	Complete set of the equipment for control of milking EC200 with pulsators like in ED200 (B1, B2), infra-red flow meters and reveal of mastitis (can be included into Milpro2 ACTO+MPD) (RF) <sup>1</sup>	15961,00

Notes:

<sup>1</sup> The cost is indicated for equipping of the milking parlor «Parallel 2x16»<sup>2</sup> It is required for each cow<sup>3</sup> It is not required for each cow

Table 3. Cost of various variants of equipping of the milking machine

Item	Variant of equipment of a milking parlor	Configuration of the equipment for cost calculation <sup>1</sup>	Cost, Euro
1.	IR-identification with IR-flow meters	$A+B1+C+N*C1+C3$	134154,00
2.	IR-identification with weight flow meters <sup>2</sup>	$A+B2+C+N*C1+C3$	141215,00
3.	IR-identification with IR-flow meters and definition of digestive activity <sup>3</sup>	$A+B1+C+N*C2+C3$	144954,00
4.	IR-identification with weight flow meters <sup>2</sup> and definition of digestive activity <sup>3</sup>	$A+B2+C+N*C2+C3$	152015,00
5.	RF-identification with transponders on collars and IR-flow meters <sup>4</sup>	$A+(D-F1+F2)+N*(D1+E1)+E2+D5$	152541,00
6.	RF-identification with transponders on ears and IR-flow meters <sup>4</sup>	$A+(D-F1+F2)+N*(D2+E1)+E2+D5$	146141,00
7.	RF-identification with transponders on ears, IR-flow meters <sup>4</sup> and implanters <sup>5</sup>	$A+(D-F1+F2)+N*(D2+E1+D3)+E2+D5+D4$	148154,00

Notes:

<sup>1</sup> The configuration of the equipment is indicated in symbols of table 2; the livestock of dairy is N=400 cows

<sup>2</sup> According to some data the relative error of infra-red way of definition of the amount of the obtained milk at the present time exceeds the error of the weight method by 7 %

<sup>3</sup> Additional function due to change of type of the applied transponder

<sup>4</sup> Conditional replacement of the equipment MPD New+Prog on EC200 for comparability of types of pulsators and flow meters in DMS-RF and DMS-IR

<sup>5</sup> The variant for search of an animal by implanted transponder in view of more frequent cases of lost of transponders by animals in comparison with collars

## 2. Objects and methods

Comparative analysis was made using the example with the milking machine «Parallel 2x16» serving the dairy consisting of 400 cows. For comparison the variants of equipping the milking parlor with DMS-IR and DMS-RF equipment with the following similar functions were selected:

- individual computer registration of the milk yield;
- individual mode of milking;
- reveal of a mastitis at the beginning of milking;
- definition of motion activity of cows;
- separation of cows from the dairy through 2-pass separating gate;
- single type of flow meters and programmed pulsators;
- automated control of the dairy.

Calculation of the cost was made with an initial data and a method provided by "Milkline" Company [1]. Initial data for calculation are presented in table 2.

The results of the cost calculation for the variants of equipping of the milking parlor being compared and their configuration are presented in table 3. Variants 1-4 correspond to DMS-IR, variants 5-7 correspond to DMS-RF. The lowest cost belongs to the variants 1 (IR) and 6 (RF), the highest cost belongs to the variants 4 (IR) and 5 (RF). The variant of identification of cows only by implanted transponders was not considered, as the characteristics of RFID system did not contain the data on possibility of reading such transponders separately at each workplace of the milking parlor.

## 3. Results and discussion

The analysis of the results of the calculation shows that the variants 1 (IR) and 6 (RF) are the most close in features, have the lowest cost and 11987,00 Euro difference in favour of DMS-IR. In group SUS-IK the cost of variant 2

differing from variant 1 by more exact weight method of measurement of the obtained milk is also lower than the cost of variant 6 (RF) by 4926,00 Euro. The cost of variant 3 (IR) providing an important function of the analysis of digestive activity of a cow is lower than the cost of variant 6 (RF) by 1187,00 Euro.

In DMS-IR without any alternative the transponders are mounted on the collars, providing the most reliable fastening on trunk of an animal. In group SUS-RCH transponders on collars are applied in variant 5 having the highest cost. As far as it can be seen from table 3, variant 4 with the highest cost in group SUS-IK has lower cost than variant 5 (RF) by 526,00 Euro. Thus in comparison with variant 5 (RF) the variant 4 (IR) carries out the analysis of digestive activity of the cow.

Variants 6 and 7 (RF) with less reliable ear fastening of transponders surpass similar variants in functions 1 and 2 (IR) by 4926,00-14000,00 Euros. They also surpass variant 3 (IR) in their cost by 1187,00 Euro and 3200,00 Euro accordingly with the function of the analysis of digestive activity of the cow.

## 4. Conclusions

According to the results of the analysis of variants of equipping of the milking parlor «Parallel 2x16» with the means of the control of milking and management of dairy for service of 400 cows dairy it is reasonably to use any of variants DMS-IR offered for comparison (table 3). Alongside with economic advantages it is necessary to develop the advanced intensive technology of yard housing of the dairy which ensures the analysis of motion (not only single-step as in DMS-RF, but also in any position of an animal) and rumination of cows.

## 5. References

1. Milkline®. Parlours price grid. Part 2 – Parallel parlours / V213E – 05.06.2008. – 20 p.