Predisposition of Mechanical Milking Plants to Dynamic Test

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Abstract
The main aim of this work is to assess the predisposition of milking plants to dynamic tests with innovative equipment in an area of south east Sicily that is particularly dedicated to milk production in order to see if they conform with the ISO Standards, given that in the future plants that are not suitably equipped will not be able to continue with quality production. The study involved a sample of 125 dairy with parlours and cow milking plants (88 direct inspections and 37 telephone researches). From the inspections carried out at the plants, it emerged that the lack of diagnostic outlets is often caused by the original design being unsuitably modified in order to adapt it to the limits imposed by the structural characteristics of the milking parlour, which generally pre-existed. In these often precarious situations, it emerged that the analogical equipment is more suitable as it consists of small instruments which do not need to be connected to one another. On the other hand, the inescapable requirements of quality production impose the execution of periodic dynamic checks, that is to say tests during milking, and it is therefore necessary to verify that plants comply with Standard UNI ISO 5707 in particular, in both the design and realisation phases. Checks on existing plants are also useful as they focus on the adjustments necessary to regularise the plant. This is indispensable for the rational use of the now available computerised equipment, which is able to guarantee results that cannot be achieved with analogical equipment. Some of the cattle-breeders reached by the telephone researches don't know exactly the mean of "dynamic test", "static test", "diagnostic outlet"; surely, it need more information if we wish obtain more milk quality and more quality in the milking plant.

Key words
UNI ISO 6690, check list, static test, diagnostic outlet

1. Introduction

According to some authors (*Madinelli & Dalvit 2002*), a static test of milking plant is not always sufficient to bring to light any abnormalities in the functioning, while the dynamic test represents a more valid tool as it can provide information regarding both the plant and the milking routine.

Starting from this assertion, the main aim of this work is to assess the predisposition of milking plants to dynamic tests in an area of south east Sicily that is particularly dedicated to milk production in order to see if that plant are conform with the ISO Standards.

The survey starts from a previous study carried out in 2005's [Schillaci] in the same district, in which dairy farm are devoted to milk high quality.

2. Materials and methods

As regulative reference framework we assume the UNI ISO Standards 3918, 5707, 6690 (UNI = Ente Nazionale Italiano di Unificazione – National Italian Unification Board).

UNI ISO 3918 contains the definitions and terms that are used in the official regulations, in research and in the construction and use of mechanical milking plants for

cows, sheep, goats and buffalos [1].

Standard UNI ISO 5707 sets out the minimum performances and the required dimensions for good functioning of milking machines, besides other requisites regarding materials, construction and installation [2]. The Standard also provides for three connection points to measure the vacuum level: at the recorder jar or terminal (A_1, Vm), near the regulator sensor (A_2, Vr) and near the entrance to the vacuum pump (Vp). A_2 is a connection point near the regulator. To allow measurement of the recovery rate, the Standard provides for a connection (Pe) to the vacuum pump outlet. With regard to the latter the means to isolate it from the rest of the plant must be present.

Standard UNI ISO 6690 specifies the precision requirements for measuring instruments and sets out the mechanical tests to verify an installation's conformity with the requirements of UNI ISO 5707. It contains a description of a static test of a plant and all the individual tests to be carried out for this.

In the fig. 1a, 1b, we can see the diagnostic outlet positions as regard 3 different kind of plants.

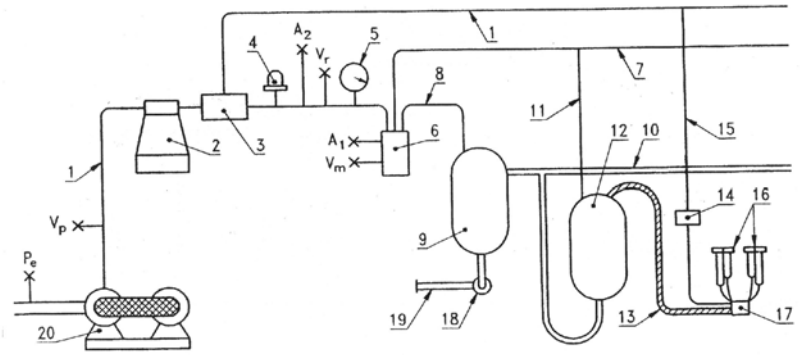

Fig. 1a – Diagnostic outlets (recording jar plant)

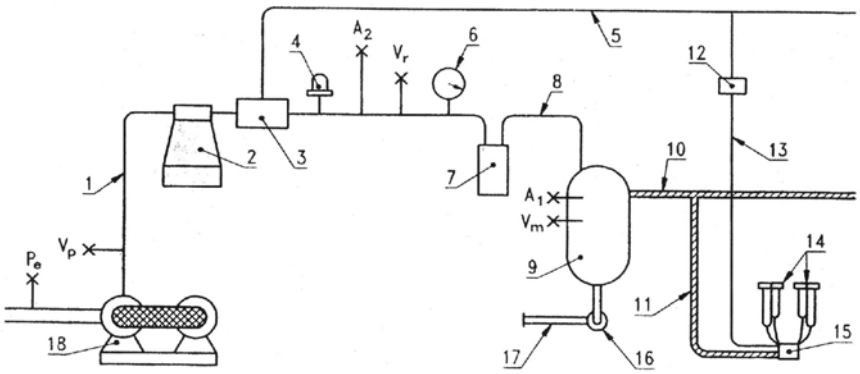

Fig. 1b - Diagnostic outlets (milk pipeline)

[1] UNI ISO 3918 also contains a description of the characteristics of milking plants. It must be pointed out that among the characteristics of the plants described in the Standard in question, there are diagrams of milking machines which also show where testing equipment should be connected.

[2] UNI ISO 5707 contains the particulars of the plant conformity test, with a description of the connection points for testing equipment (also given in the milking machine diagrams in Standard ISO 3918) to permit measurement of system reserve and unit consumption.

Static control of milking machines.
They are carried out by using an analogical equipment that includes 2 flowmeters, (0 - 1,650 and 0 - 3000 L/min), 1 precision vacuum gauge (diam. 150 mm), 1 revolution counter, 1 pulsograph and various recording instruments. With the flowmeters it is possible to measure the air flow of the vacuum pump, the system reserve and the unit consumption. They are periodically calibrated and are accurate to within ± 2% of the true reading.
Dynamic control of milking machines.
It was used a digital equipment that has the advantage of incorporating in one device all the measuring functions that are otherwise carried out by numerous separate analogical tools, thus permitting simultaneous memorisation of the parameters on a laptop. The acquisition of data takes place thanks to a series of transducers, placed at three different points of the plant to be checked and able to convert the various physical entities to be measured (pressures, differential pressures, flows etc.) into electrical signals. This means it is possible to obtain measurements at the same time at different points of the plant, as required by law, and also to operate in both static and dynamic conditions.

An important characteristic of DAS-M is represented by the fact that the tests can be carried out by attaching at least three sensors to the plant, thus collecting values relative to the vacuum fluctuations at different points of the plant – the receiver, the air pipeline near the separator and the milk pipeline– contemporaneously, correlating the results in time.
As methodological aspects, the study by direct inspection was carried out on a sample of 88 dairy farms; others 37 farmers were involved by telephone researches. We asked them some very simple queries, as: if they knew the means of "dynamic test", "static test", "diagnostic outlet", ISO UNI 3918, 6690, 5707".

All the dynamic tests conducted with computerised equipment included the recording of the presence and arrangement of diagnostic outlets on each type of milking installation. The description and symbols used for the positioning of the diagnostic outlets are those given in the relative regulations.

As regards the dynamic tests with analogical equipment, such notes were not taken. In fact, these tests are always possible given that the diagnostic outlet is obtained by disconnecting the receiver. Considerations on the data, the problems met with and the solutions adopted were made with reference to the current regulations (UNI ISO 6690).

The dynamic and static tests assessed the plant's functional parameters with bearing on its dimensioning and on the saf eguard of the health of the herd and the hygiene of the milk. The parameters considered involved measuring the vacuum fall in the air and milk pipelines, the vacuum pump capacity, the air pipeline consumption, the milk pipeline consumption, the cluster consumption, the pulsation group consumption and the effective vacuum reserve.

All the data collected with the computerised equipment are the result of a calculation system that every 5" integrates the values recorded, obtaining the mean vacuum level, while the highest and lowest values are defined the maximum and minimum vacuum level respectively. A 10 minute recording period was set so as to guarantee reliability and the measurements carried out near the receiver cover the entire duration of the milking of a single animal. Those relative to the vacuum line also include the phases of attachment and removal of the milking groups.

Fig. 2 – Analogical devices

Fig. 3– Computerized devices

3. Results and discussion

With regard to the study of aspects connected to the *static ("dry") test*, 88 milking plants of various types were visited. Only 27 of these (31%) were all the diagnostic outlets required by law found. Expressing this in more detail - 5 milk pipeline plants out of 16 (31%), 10 bucket plants out of 36 (28%) and 12 recorder jug out of 36 (33%) were found to comply with the law. The remaining installations had only some of the diagnostic outlets necessary for the checks and some had none at all.

Only 31% of the milk pipeline plants had all the diagnostic outlets required to measure the vacuum level *(Vm, Vp, Vr)*; the reverse pressure (*Pe*) could not be measured in 56% (50%-2005) of the farms and in only7 (5-2005) cases could the air flow be measured near both the terminal jar (A_1) and the regulator sensor (A_2).

Moreover, as regards the recorder jar plants, it was observed that for the measurement of the vacuum level only 11% installations had all three diagnostic outlets required; with respect to the reverse pressure, in 66% of the cases, measurement could not be carried out; as regards air flow, in 42% (39%) plants the diagnostic outlet was near the sanitary separator (A_1) and 47% (33%) near the regulator sensor (A_2).

Out of 36 bucket installations, in 72% it was not possible to measure the reverse pressure, only 28% had both the outlets required for the vacuum level and in 22% to measure

the airflow it was necessary to dismantle the vacuum pipeline to obtain a suitable connection, this causing notable operational difficulties.

Dynamic tests were carried out on a total of 18 farms, of which 5 had milk pipeline plants and 13 had recorder jar installations (tab. 2). The tests were carried out in each of the plants with analogical (MIBO) and digital equipment (DAS-M).

As stated in the methodology section, the survey of aspects connected with the dynamic testing of milking plants only regarded the tests carried out with DAS-M.

As regards the milk pipe line installations, 1 out of 2 had all the diagnostic outlets required by the equipment software, that is to say near the terminal jar, on the milk pipeline and on the receiver.

As regards the recorder jar plant, 3 out of 5 had all the diagnostic outlets required by the equipment software.

Similarly, in the plant without the three outlets, the three transducers were attached to three collectors of the teatcup groups.

4. Conclusions and prospects

In contrast with the widespread objectives as regards quality, only a limited number of plants in the vast number in the sample was found to conform with the regulations and therefore to be able to carry out routine checks with computerised equipment.

From the inspections carried out at the plants, it emerged that the lack of diagnostic outlets is often caused by the original design being unsuitably modified in order to adapt it to the limits imposed by the structural characteristics of the milking parlour, which generally pre-existed. In these often precarious situations, it emerged that the analogical equipment is more suitable as it consists of small instruments which do not need to be connected to one another. These characteristics permit the use of analogical equipment even in narrow spaces and difficult working conditions, represented by components that can only be reached with difficulty or parts that are hard to see and inspect. On the other hand, the inescapable requirements of quality production impose the execution of periodic dynamic checks, that is to say tests during milking, and it is therefore necessary to verify that plants comply with Standard UNI ISO 5707 in particular, in both the design and realisation phases.

Telephone research shows that several (and very good) farmers of the sample don't know the correct mean of "static test", "dynamic test", "diagnostic outlet" and, overall. They don't know if their plant were equipped with correct diagnostic outlets and because they are very important to obtain quality milk and to increase animal welfare.

The research shows that information about the topic should be spread and that a considerable amount of resources should be utilised to set up milking plant if we really wish obtain high quality milk and chease.

With this aim during the research a check list was drawn up of each of the three different types of plant studied (milk pipeline, recorder jar and bucket).

By using these, operators themselves will be able to verify in the design and realisation phases whether the plants really comply with the regulations and have diagnostic outlets. The same check lists will be brought to the attention of the technicians working for the technical assistance services for a preliminary assessment of milking plants.

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