

# IMPROVING WORKING CONDITIONS BY USING MEDIUM PRESSURE (40 BARS) DURING CLEANING IN PIG FARMS

Corrégé, I. <sup>1</sup>, Lanneshoa, M. <sup>1</sup>, Hémonic A. <sup>1</sup>, Guérineau S. <sup>2</sup>, Proux, C. <sup>3</sup>

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*1 IFIP – Institut du porc, France;*  
*2 ENDEA, France;*  
*3 MSA des portes de Bretagne, France*

## SUMMARY

Cleaning with a medium-pressure nozzle (Fitjet® nozzle, 40 bars) was compared to conventional cleaning at high pressure with a rotary nozzle (160 bars), based on criteria such as working time, water consumption, cost, difficulty of work and cleaning efficiency.

The results suggest that the cost is similar and the cleaning score with contact plates is correct for both

nozzles. Concerning the difficulty of work, the results favour the Fitjet® nozzle: the noise level is significantly lower, the visibility during washing is significantly higher, musculoskeletal disorders are lessened, projections towards the operator's face are significantly reduced and cleaning is considered less difficult and less tiring for the operator.

## INTRODUCTION

Cleaning rooms represents significant physical constraints for the operator: a risk of developing musculoskeletal disorders and other difficulties such as: noise, vibration, splashes of water and organic matter in eyes.

The objective of this study is to compare cleaning with a medium-pressure nozzle (Fitjet® nozzle) to a conventional cleaning at high pressure with a rotary nozzle, based on criteria such as working time, water consumption, cost, difficulty of work and cleaning efficiency.

## MATERIAL AND METHODS

Two modalities of cleaning, high pressure (160 bars) with a rotary nozzle and medium-pressure (40 bars) with a Fitjet® nozzle, are compared for eight observations: 3 in farrowing, 3 in post-weaning and 2 in fattening. For each repetition, the modalities are applied by the same operator, previously trained, in the same room. The protocol is identical, only the nozzle type, used during the prewash, washing and rinsing, changed.

The work time and water consumption allows to calculate the cost of the operations from a method developed in a previous publication [1].

The effectiveness of the cleaning and disinfection is assessed by visual scoring, visual semi-quantitative scoring with paper roll and Total bacteria counts in Petri dishes, according to the method previously described by Corrégé et al. [2], [3].

Noise is measured with a sound level meter, placed near the shoulder of the operator, on different materials

(plastic, stainless steel, galvanized steel, brick, concrete and cast iron) and distances (20, 30, 40 and 70 cm).

The importance of mist generated during the washing is measured too. Adhesives marked with squares are installed in different parts of the room: the number of adhesives and squares, that we can observe during the washing are regularly recorded.

The hardness of the cleaning for the operators is described by a specific questionnaire developed by IFIP, which takes into account the constraints of posture, noise, visibility, splashing and the overall difficulties. Finally, an ergonomist from the Agricultural Social Mutual Insurance (MSA) noted the number of postural constraints (curvature of the back above 30° and upper limbs above the heart) and stop-start motions.

The Student t test, the Wilcoxon nonparametric test and the Anova (SAS) are used for data processing.

## RESULTS

The working times are higher in farrowing with the Fitjet® nozzle, but lower in post-weaning and fattening (Table 1). Water consumption is also lower in post-weaning but higher in farrowing and fattening. Economically, the use of the Fitjet® nozzle involved an additional cost in farrowing,

but a reduction in post-weaning and fattening. Per sow and per year, with the Fitjet® nozzle, there is a profit of 0.49 € per productive sow, for a 168 sows farrow-to-finish farm (Table 1).

Table 1: Comparison of the Fitjet® and rotary nozzle results

<b>Difference Fitjet® - Rotary nozzle</b>	<b>Water- l</b>	<b>Time-min</b>	<b>Cost- €</b>
Farrowing– 100 m <sup>2</sup>	509/+12% (1)	19/+10%	11.23/+12%
Post-weaning – 100 m <sup>2</sup>	-1153/-21%	-35/-12%	-20.58/-15%
Fattening – 100 m <sup>2</sup>	140/+3%	-11/-5%	-1.43/-1%
Per sow/year (2)	4/+0%	-3/-1%	-0.49/-1%
	<b>Fitjet®</b>	<b>Rotary nozzle</b>	<b>Stat</b>
Noise in dB	86.6	93.3	p<0,001
Visibility : % of visible squares	96.0	97.7	p<0.01
Visual semi-quantitative scoring	1.76	1.83	ns (3)
Total bacteria counts	1.93	2.10	ns
(1) Value / percentage of the difference / (2) Calculation for a 168 sows farrow-to-finish farm			
(3) ns : no significant at the threshold of 5%			

Concerning the cleaning efficiency, the results obtained with the visual semi-quantitative scoring by paper roll and with the Total bacteria counts in Petri dishes are not significantly different between the two nozzles (Table 1).

Table 2: Noise measurement (in decibels)

<b>Distances</b>	<b>Rotary nozzle</b>	<b>Fitjet®</b>	<b>Difference Fitjet® - Rotary nozzle nozzle</b>
20 cm	96.4	90.1	- 6.3
30 cm	96.5	89.7	- 6.8
40 cm	93.6	87.0	- 6.6
70 cm	88.8	82.2	- 6.6
No impact	86.1	77.7	- 8.4
<b>Materials</b>	<b>Rotary nozzle</b>	<b>Fitjet®</b>	<b>Difference Fitjet® - Rotary nozzle</b>
Plastic	96.2	89.5	- 6.7
Stainless steel	94.3	87.4	- 6.9
Cast iron	94.0	86.8	- 7.2
Concrete	93.8	86.4	- 7.4
Brick	92.8	90.7	- 2.1
Galvanized steel	91.8	82.9	- 9.8
Ceiling	87.4	78.9	- 8.5

Sound intensity decreases when the distance between the nozzle and the surface to clean increases (Table 2). It also varies with the type of materials, galvanised steel generates the least noise and plastic the most (Table 2). For all distances and materials, the noise level is significantly lower with the Fitjet® nozzle: the difference between the nozzles varies from 2.1 dB (brick) to 9.8 dB (galvanized steel) and the average difference is about 6.7 dB. The decibel scale is logarithmic; these differences equal a noise level that is respectively 1.6, 9.8 and 4.7 times lower. In addition, 99% of the noise measured with the rotary nozzle exceed the risk threshold for hearing (85 dB) cons 60 % with the Fitjet® nozzle.

Regarding the visibility tests, all adhesives were observed with the two nozzles. However, the number of squares observed is significantly higher with the Fitjet® nozzle.

About the hardness of cleaning, the operators are in favour of the Fitjet® nozzle. In fact, the pains are significantly smaller with the Fitjet® nozzle for the arms and shoulders the day of washing and for the fingers, wrists, arms and shoulders the day after washing (Figure 1).

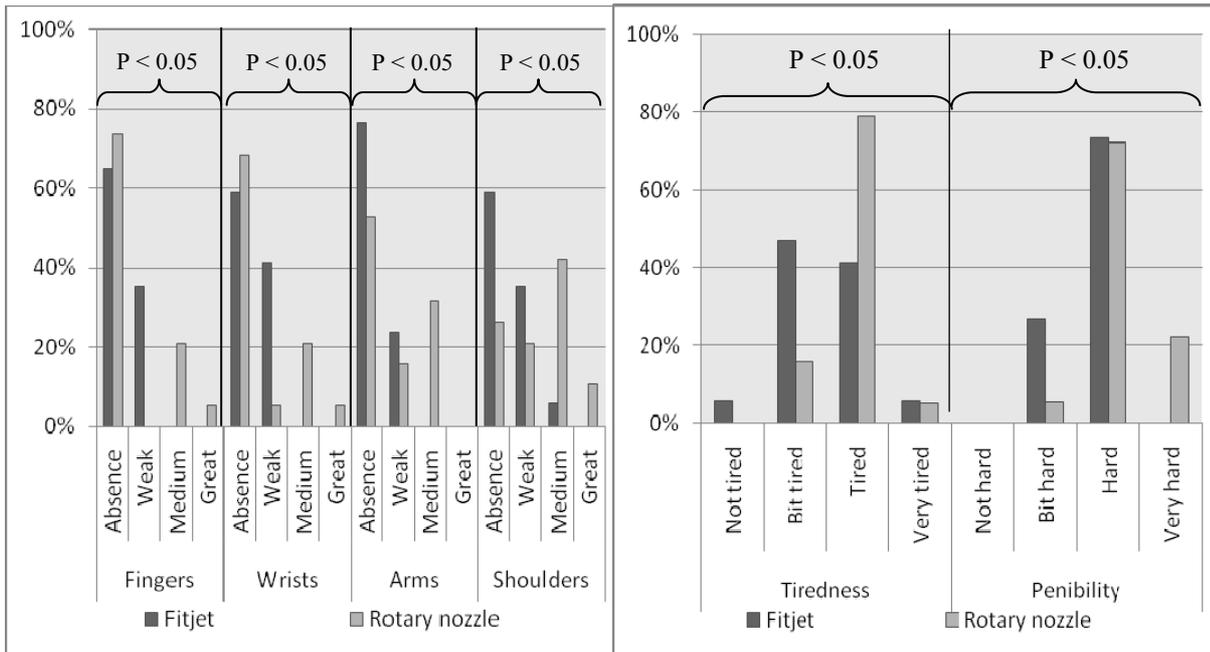


Figure 1 - Pains the day after washing

Figure 2: Tiredness and penibility

There is no difference concerning the noise but the visibility is perceived as worse with the rotary nozzle. The face projections are significantly higher with the rotary nozzle.

The state of tiredness and difficulty are considered significantly lower with the medium-pressure. (Figure 2).

Finally, the ergonomist of the MSA noticed a decrease of the mist produced, the vibration effects and jerks experienced by the operators with the Fitjet® nozzle. The number of stop-start motion is substantially equivalent between the two nozzles.

## DISCUSSION

The cost is similar between the two nozzles, for the same cleaning efficiency. However the Fitjet® nozzle requires a prior soaking phase and a change in work habits, with a time of adaptation different according for the operator.

Concerning the noise, the recommended working distance with the Fitjet® nozzle is 70 cm whilst it is 30 cm for the rotary nozzle. This accentuates the noise decrease level. The difference between the Fitjet® nozzle at 70 cm and the rotary nozzle at 30 cm is about 14 dB or 25 times less noisy. The operators do not notice any difference in noise disturbance, the hearing protection they wear probably reduces the difference between the nozzles.

The evaluation of the hardness confirms the results of the study on the painfulness during cleaning operations [4]:

the rotary nozzle shows projection of organic matter in eyes, poor visibility in saturated atmosphere with water and shoulders and wrists pains.

The Fitjet® nozzle has a greater manoeuvrability and allows less pressure so we can hold it in just one hand, which facilitates the access to some areas. In addition, it offers the possibility to work with a rotary or fixed position, so it's possible to perform various stages of washing with the same nozzle.

The impact of the medium and high pressure on the wear of materials is not included in this study. The wear of materials has consequences in the medium and long term on the cost, the effectiveness and the difficulty of cleaning: indeed, materials with many asperities because of erosion are more difficult to clean and to disinfect.

## CONCLUSIONS

With the Fitjet® nozzle the water consumption, the working time and the cost are similar to those generated by high pressure (rotary nozzle) for the same washing efficiency. Concerning the hardness of work, it leads to improved visibility, reductions of the noise, the

projections, the postural constraints and the perceived pains. However, it needs a prior soaking phase and a change in work habits, with a time of adaptation for the operator, necessary to optimize the working time, the painfulness and the costs.

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