PRELIMINARY STUDY

- REDUCTION OF HARMFUL ENVIRONMENTAL COMPOUNDS INSIDE A FARM -

CONTENT

CHANGE CONTROL

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1. OBJECTIVE

The objective of this study is to evidence the reduction of the concentration of ammonia (NH3), volatile organic compounds (VOCs), formaldehydes (HCHO) and suspended particles (PMs), present inside a pig farm, as well as to evaluate the effect of said air quality improvement on the production of said farm.

New equipment developed by AIRTÈCNICS will be used, which incorporates active and passive air disinfection and purification technologies: filtration, photocatalysis and generation of hydroxyl radicals (OH·).

In order to analyze the performance of the equipment, the evolution of the concentration of the named contaminants in several similar rooms will be studied, one of them with the equipment installed and the rest as control rooms (without equipment).

2. SCOPE

Each box fulfills the function of a particle collector (filtration), as well as purification/disinfection of the environment and nearby surfaces, with a range of up to 300m3. Said purification/disinfection will be achieved with the inclusion of a technology for the generation of OH radicals inside each module, as well as with the incorporation of photocatalytic fans (Kleenfan).

- The **radical reaction** is directly related to the mixture between the emitted ozone and evaporated hydrogen peroxide (H2O2). It is for this reason that each unit includes a H2O2 tank, which must be replaced with certain frequency (nominally every 4 months).

- The **photocatalysis** produced in the fan blades – activated by solar energy or UVA rays – is, in itself, a passive technology, a natural principle that imitates photosynthesis and eliminates common pollutants in the atmosphere such as carbon monoxide and nitrogen and sulfur oxides (VOCs, NOx and SOx), through an oxidation process activated by solar energy. However, if the environment in which it takes place has a relative humidity equal to or greater than 55%, photocatalytic technology acts as an active technology because the hydroxyl radicals that are generated have the ability to propagate.

Taking into consideration a preliminary location (subject to change) of the ventilation systems, such that the concentration reduction of the aforementioned pollutants would be optimal, the following aspects will be analyzed – in contrast to the control rooms:

- **Ambient temperature** of each room. Temperature is a parameter that directly affects the evaporation rate of hydrogen peroxide from the purification/disinfection equipment cartridge.
- **Performance of the ventilation system** in each room. It is essential that the ventilation of each room covers the entire space, in such a way that the hydroxyl radicals are distributed evenly, disinfecting each surface and corner of the interior volume.
- **Concentration of pollutants.** The main contaminants present in a pig farm have been taken into account:

- **Ammonia.** The decrease in ammonia gas concentration in the purified room, in contrast to the control room, will be analyzed. Legislative limit value: 20 ppm (RD 692/2010)
- **Formaldehyde.** The decrease in formaldehyde concentration in the purified room, in contrast to the control room, will be analyzed.
- **VOCs.** The decrease in the concentration of volatile organic compounds in the purified room, in contrast to the control room, will be analyzed.
- **PMs.** The decrease in the concentration of suspended particles in the purified room will be analyzed, in contrast to the control room

3. RESULTS

During a 73 days period, the reduction of the aforementioned contaminants was assessed in the maternity room of the farm, where two purification/disinfection equipment with a cyclone filter (purified room) were installed.

Figure 1. Prototype of the equipment with Cyclonic system. Airflow:100 m^3/h.

Figure 2 shows a scheme of the distribution of each key element inside the purified room of the farm. All farrowing rooms are the same size: 6 rows of 7 sows placed in farrowing pens in a row. Each room includes approximately 1,700 seats.

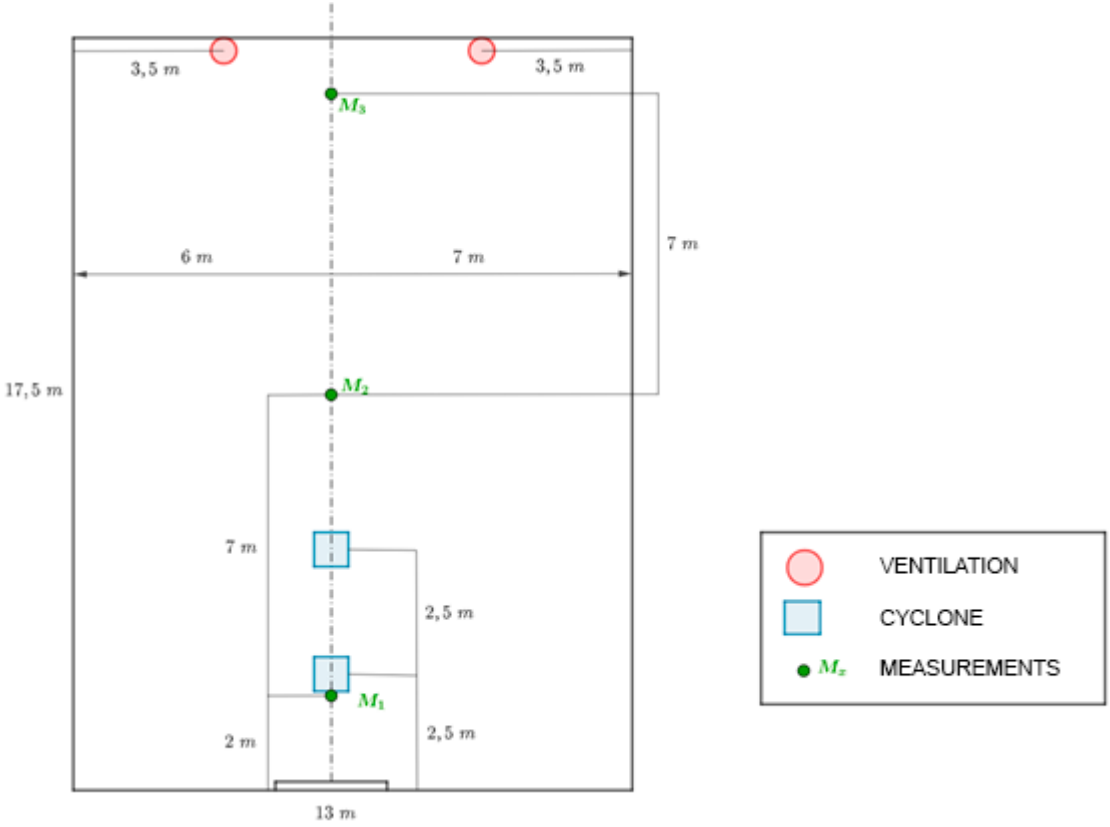

Figure 2. Scheme Purified Room.

As can be seen, along the central corridor each piece of equipment with a cyclonic filter has been located, as well as the three measurements of air quality carried out. The ventilation system is installed on the wall opposite the entrance.

During the tests, it was not possible to quantify the ventilation flow of each of the rooms because they have an automatic regulation system according to needs and the openings of the air inlets (manual) are different in each room. Likewise, the ambient temperature in all the rooms turned out to be very similar and around 22-25ºC. The following table shows the results obtained.

Table 1. Increase in emissions per room compared to the purified room (Room 8). Period: 5/3/2021 – 17/5/2021..

	Room 7	Room 8	Room 9	Average
Ammonia	12%	With devices	18%	15%
Formaldehydes	22%	With devices	21%	21,5%
VOCT	25%	With devices	24%	24,5%
Particles	28%	With devices	28%	28%

Casualties in the purified room have also been compared to the other study rooms (control rooms).

Table 2. Casualties s in the purified room with respect to the other study rooms (control rooms).

	Room 7	Room 8 (with devices)	Room 9	Average Deaths (Rooms 7 and 9)	Reduction (%)	Reduction (heads)
Lot 1	171	110	92	131	16,0%	21
Lot 2	90	85	137	113	24,7%	28
Lot 3	216	95	133	174	45,4%	79
Total	477	290	362	**419**	**30,8%**	129

4. CONCLUSIONS

It has been possible to demonstrate the reduction of the concentration of ammonia (NH3), volatile organic compounds (VOCs), formaldehydes (HCHO) and suspended particles (PMs), present inside a pig farm, as well as to evaluate the effect of said improvement of the quality of the air in the production of said farm, obtaining as a result an average reduction in mortality of 30,8%, which is equivalent to 129 heads in 3 months.

If we extrapolate the results obtained, an increase of around 516 heads per year could be achieved. If the cost associated with the sow stage is €24.22/pig, the incorporation of air purification/disinfection equipment could lead to savings of up to €12,497.52/year.

However, the results collected in this report are preliminary and should be treated as such, being necessary to validate the equipment in each particular case. A longer-term mortality study is also recommended to be able to draw more definitive conclusions about increased production.