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# Control of biotrickling filter efficiency on $NH_3$ emitted by piggeries

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***Ammonia generated by piggeries can be removed using biotrickling filtration which is considered as an efficient technique. The transfer of ammonia into water can successively generated ammonium ions which are afterwards oxidized into nitrite and nitrates ions. The accumulation of nitrogen salts in the water can affected the removal efficiency (RE). The objectives of the study (TARA project) is to establish links between nitrogen salts and Electrical Conductivity (EC – measurements on field conditions) and the nitrogen mass balance of a pilot scale biotrickling filter (measurements on pilot scale biotrickling filter).***

## Water samples on field conditions

- Six biotrickling filters installed on pig farms located in Britanny (France)
- Water sampled on the surface (« surface water ») and at the bottom of the tank (« deep water »)
- Measured parameters : EC (EC meter WTW cond 340i), concentration of NH4+ (spectrophotometric Nessler method 420 nm), $NO_2^-$ et $NO_3^-$ (Dionex DX 120 ion chromatograph)

## Experimental procedure on the pilot

- Biotrickling filter treating the polluted air generated by 54 fattening pigs (Ifip experimental farm in Romillé, France)
- Experiments carried out during 14 weeks (02-18-2018 to 05-21-2018)
- Airflow rate : 1350 $m^3.h^{-1}$ /Empty Bed Residence Time : 1s/Water volume of the buffer tank : 542 L
- Measured parameters on the gas phase (1 time per hour) : temperature (thermocouples type K), relative humidity (Voltcraft DL 121TH), $NH_3$ concentration (Innova Lumasens Technologies)
- Measured parameters on the liquid phase (1 time per week) : temperature (thermocouples type K), pH, EC (EC meter, WTW Cond 3320), nitrogen salt concentrations (Dionex DX 120 ion chromatograph for $NO_2^-$ and $NO_3^-$ and spectrometric Nessler method for $NH_4^+$)

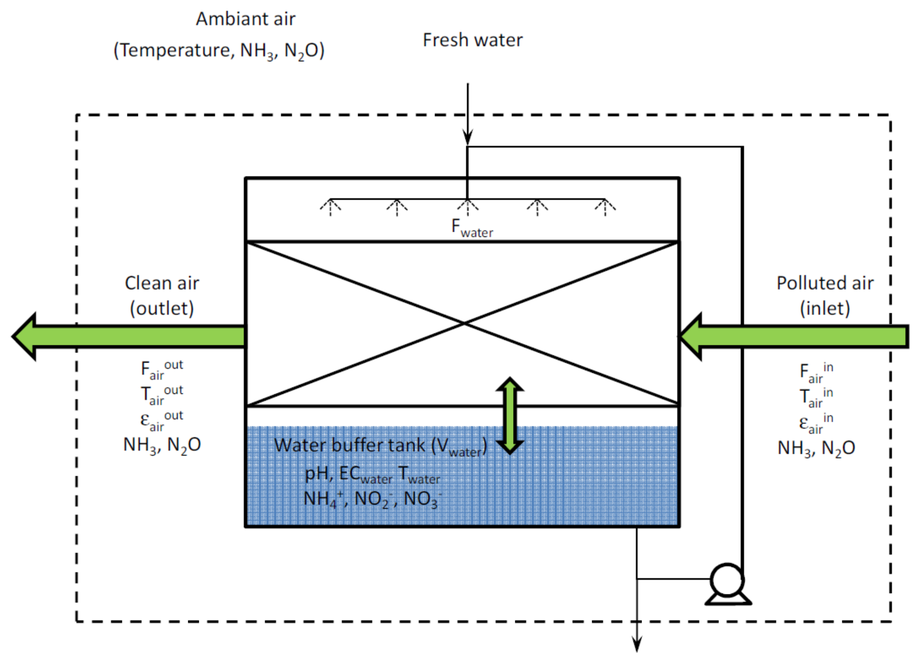


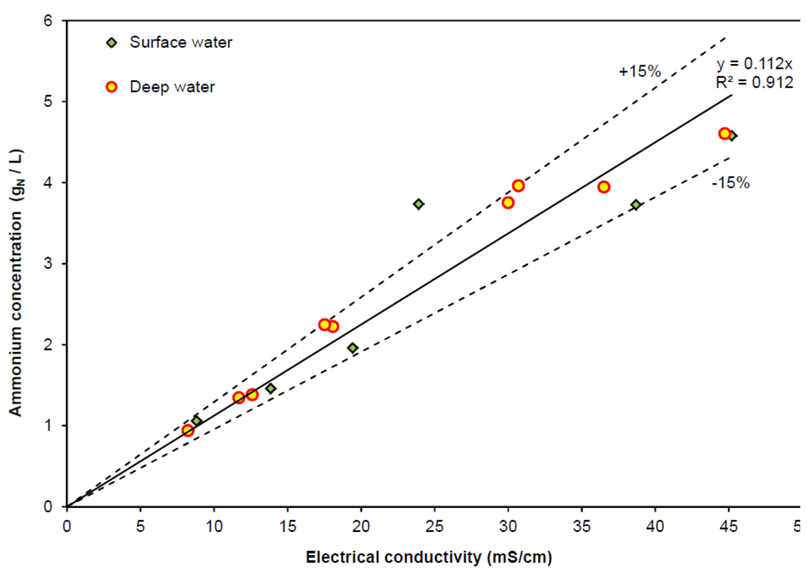

**Figure 1** – Sketch of the pilot scale biotrickling filter and associated measurements

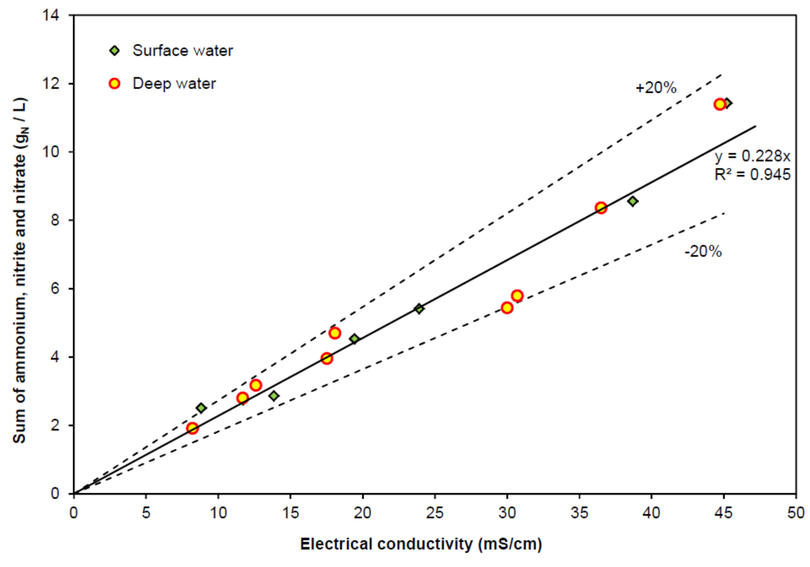
## Main results

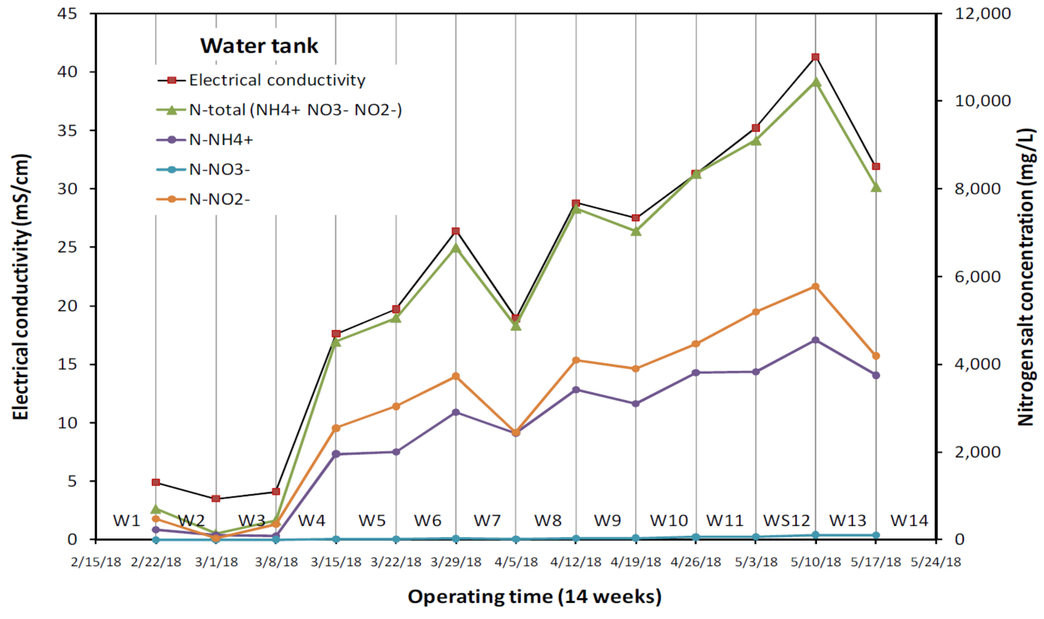
### Pig Farms

$$[NH_4^+]_{gN/L} = 0.11\ EC_{mS/cm} \text{ (accuracy ± 15\%)}$$
$$\text{Or } EC_{mS/cm} = 8.9\ [NH_4^+]_{gN/L}$$

$$\Sigma\ ([NH_4^+] + [NO_2^-] + [NO_3^-])_{gN/L} = 0.23\ EC_{mS/cm} \text{ (accuracy ± 20\%)}$$
$$\text{Or } EC_{mS/cm} = 4.4\ \Sigma\ ([NH_4^+] + [NO_2^-] + [NO_3^-])_{gN/L}$$




### Pilot

- $NH_3$ concentrations in the polluted air : from 5 to 35 $mg/m^3$ – Removal Efficiency : 20 – 40%
- Mass balance between phases verified (5% differences)
- Constant mass transfer of ammonia between air and water : 3,22 g.h-1 corresponding to 10,0 $g_N.animal^{-1}.week^{-1}$

## Conclusion and perspectives

EC and nitrogen salts in water are correlated. This can be an useful tool to control the accumulation of salts and then the removal efficiency of biotrickling filter. In the pilot scale filter, the mass balance between phases was verified with an accuracy of 5%. Further experiments are needed to determine the threshold value of the total nitrogen concentration in water to calculate the amount of water that have to be used to ensure a good operating of biotrickling filters.

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