State of the art of digestates in France and of their agronomic value

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Agricultural AD system

Mechanically separated municipal waste AD system

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Management of organic residues from anaerobic digestion is becoming a critical topic for the entire biogas production in France since digestate is still considered as a waste by French regulation. A review of digestates composition and agronomic value was done to help changing its status from waste to product.

Figures of French anaerobic digestion

The potential amount of organic waste collectable in France is about 214 million tons (Figure 1). About 70% is made of solid wastes from agriculture and municipalities.
Although, so far, most common applications of anaerobic digestion were for industrial effluent and urban sludge treatment (Table 1), actual development concerns mainly agricultural and territorial units. About a hundred new plants are under construction or study in these sectors.

Figure 1: Million tons of organic waste and residues in France

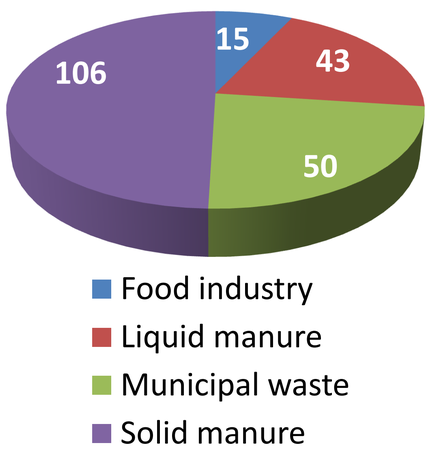
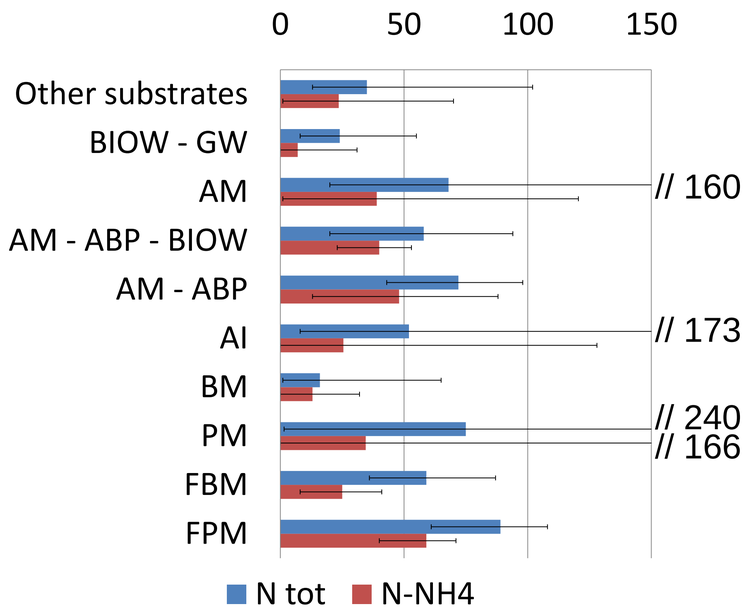


Table 1. Plants and biogas production (excluding landfill gas in France in 2011 (data from ATEE, Club Biogaz 2011)

Sector	Number of plants	Waste treated (T of $/year)	Biogas production (NM^3/year)	Cumulated electric power (MW)
Industry	80	149 400	57 000 000	1 765
Wastewater treatment	60	17 000 000	140 000 000	12.2
Agriculture	48	103 500	34 652 000	9.6
Household waste	9	20 000	64 000 000	16.4

$ is dry matter for Industry and Agriculture, people equivalent for wastewater and raw matter for household waste

Characteristics of about 160 raw digestates



- Basic pH around 8
- Variable nutrients composition depending on the substrate digested
- High levels of NPK for digestates from pig manure and animal by-products
- Higher NH_4/Ntot and lower C/N ratio for digestate compared to their substrates
- Excess of copper and zinc for agricultural digestates
- Biological parameters are usually not a problem except for *Clostridium perfringens.*

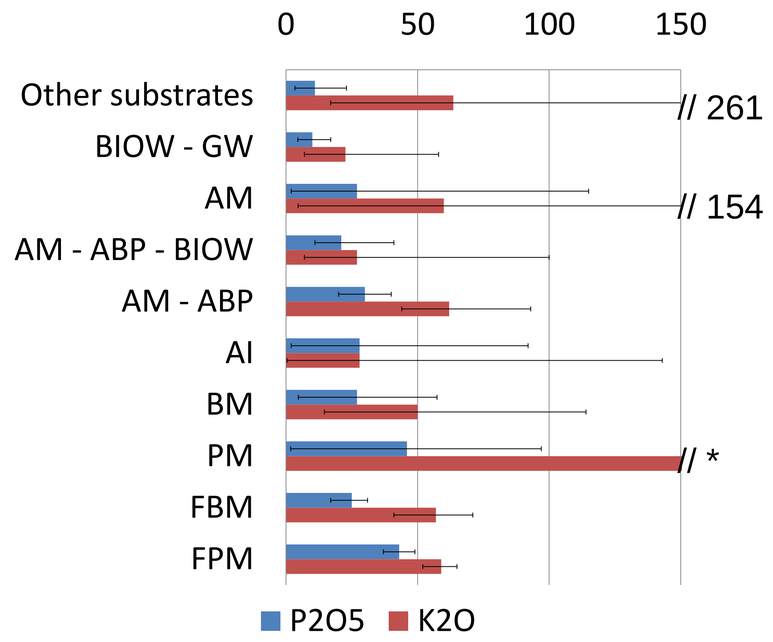


*Figure 2: Nutrient composition (mini, mean, maxi g/kg DM) of about 160 digestates of various origins compiled from ADEME / RITTMO 2011 and data from the agricultural sector. BIOW: biowaste; GW: greenwaste; AM: mixture of animal manures; ABP: animal by-products; AI: agrifood industry waste; BM: bovine manure and PM: pig manure, F: French agricultural data. *, only 2 data (mini 189, mean 204, maxi 219)*

Field studies and agronomic value of digestates

- Literature is poor and contradictory
- Global trend is interest for bioavailable nitrogen that may increase crop yields compared to undigested substrates (6 to 20% increases for digestate from agriculture residues)
- Crop yields generally lower with digestate fertilization than those obtained with mineral fertilizers but long-term effect can be expected
- Results vary greatly with weather conditions suggesting that key points are improving the application materials to limit ammonia volatilization and get more data about ammonia and volatile fatty acid plant poisoning as well as back effect of organic matter.

This review is part of the research project DIVA funded by the ANR (French Research National Agency).
Data comes from the DIVA project and from:
• ADEME et ATEE Club Biogaz 2011. Etat des lieux de la filière méthanisation en France. 61p.
• ADEME et RITTMO 2011. Qualité agronomique et sanitaire des digestats. 141p.

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