

RESULTS OF AN ITALIAN INTERLABORATORY STUDY ON BIOCHEMICAL METHANE POTENTIAL

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HIGHLIGHTS

The first Italian interlaboratory study on BMP assessment highlights the need for protocols harmonization. Despite relevant parameters were similar for all participants (I/S=2, temperature=35-39°C), an average standard deviation of 58% was found on the entire data set, reduced to 19% after selecting BMP results corresponding to a degradability in the range 50- 100%.

Keywords

Interlaboratory study; BMP ; cheese whey; silage maize; biowaste.

THE INTERLABORATORY STUDY

The Bioenergy Factory (Politecnico di Milano) promoted a national interlaboratory test aiming to compare Biochemical Methane Potential (BMP) testing methodology. 43 labs from all over Italy were invited to the interlaboratory study and 19 among private and academic/research labs joined. Three freeze-dried samples were shipped to each lab: cheese whey, silage maize, biowaste. In Table 1, their elementary composition is shown together with the corresponding theoretical BMP values (BMP_{Th}) in case of 100% anaerobic biodegradation. The latter was assessed by using the Symons and Buswell (1933) formula referred to a generic C_aH_bO_cN_d organic molecule.

Participants were free to apply their typical BMP measuring protocol with the sole following constraints: (i) BMP tests had to be done in triplicate by including a blank sample; (ii) the inoculum to substrate ratio (I/S) had to be fixed at 2; (iii) the BMP test had to last for a minimum of 30 days. Participants were asked to report relevant operating conditions (inoculum origin, methane measurement method, temperature, reactors volume, mixing conditions, added chemicals).

RESULTS

The inocula came from conventional or high-rate digesters fed on waste sludge, agricultural or industrial wastes. All tests were performed under mesophilic conditions (between 35 and 39 °C).

The reactors volume varied between 0.25 and 8.5 L. Methane production was quantified by both manometric (26%) and volumetric (74%) methods.

Table 1 Elementary composition of the three samples used for the BMP test.

	Humidity ⁽¹⁾ (g/100g)	Ashes ⁽¹⁾ (g/100g)	Elementary composition ⁽²⁾ (g/100g)						BMP _{Th} mL _{CH₄} /g _{VS}
			C	H	N	S	Cl	O	
Cheese whey	2.1	6.6	38.8	6.2	1.60	0.13	1.29	43.3	417
Silage maize	2.6	3.8	45.2	6.1	1.15	0.12	0.41	40.6	477
Biowaste	5.0	8.2	45.1	6.3	3.45	0.24	0.39	31.3	542

Methods: (1): ASTM D7582-12, (2): UNI EN 15408:2011

Out of the 19 participants, only 14 of them reported the BMP values after 30 d of digestion (BMP₃₀) for silage maize and biowaste, while 16 of them reported BMP₃₀ values for cheese whey. The available BMP₃₀ data are summarised in Figure 1.

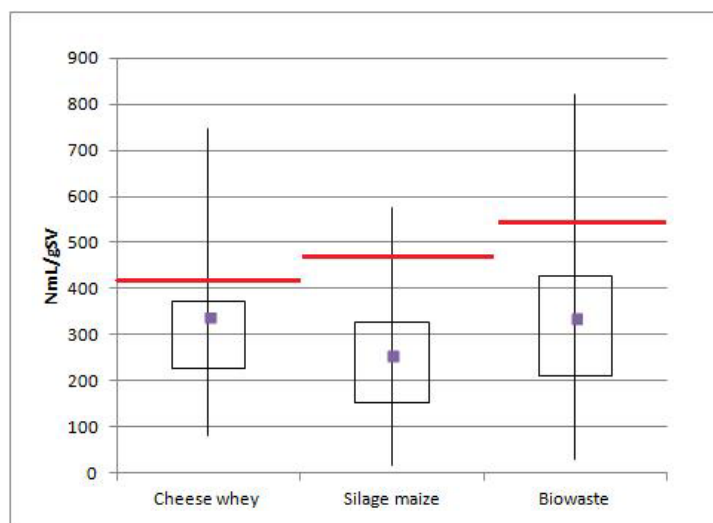


Figure 1. Box-plots of the BMP₃₀ data; the red line corresponds to BMP_{Th} value.

By taking into account the overall data, average BMP₃₀ of 339, 256, 337 NmL/gVS and standard deviations of 53, 61, 61 % for cheese whey, silage maize and biowaste respectively were obtained. However, it must be pointed out that numerous values (11%) are above the BMP_{Th} and 34% fall below the 50% of the BMP_{Th} values and are therefore unlikely or impossible for the tested substrates. Testing conditions did not appear to have any significant correlation with BMP₃₀ values.

Results of this interlaboratory study confirm the need for the harmonisation and standardization of BMP testing as suggested by previous and similar attempts (Raposo et al, 2011).

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