BIOGAS FERMENTATION RESIDUES' EFFECT ON THE FORMATION TENDENCY OF THE SOIL AGGREGATES

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Abstract: The organic materials which mixed into the soil have serious impacts on the formation tendency of the soil aggregates. In the past some of the by-product in the animal husbandry, which can be used for fertilizing, including manure and slurry had utilization problems, because of their low nutrition content and high land application costs.

The facts, like the improving impacts of the organic materials on the soil life and structure and the regulations which governs the storage of this products and considers these by-products as hazardous waste, highlighted the re-usage of this materials. The sewage and the non-hazardous organic material waste which generated during the solid waste management can be used for fertilizing after appropriate treatment. We examined under laboratory conditions the fermentation residues' improving effect on the soil structure. With mechanical interference we redound the formation tendency of the soil aggregates which evaluated by optical inquiry. The soil surface illumination from different angels causes different shadow effects, which can be measured from above. By the shadow effects the roughness of the soil surface can be esteem. In this way with remote sensing the effect of the soil tillage can be evaluate. By machine equipped instrument on the fields or in laboratory conditions with this method the soil structure can be describe.

Keywords: biogas fermentation, soil aggregates,

Introduction

The soil's organic and inorganic content have serious impact on the formation of the soil structure. The primary soil particles forms aggregates by the colloids and mechanical impacts. The artificial mechanical effects could improve or decrease this forming process. Mixing organic materials as adhesives into the soil can mend the soils' physical characteristics. Important to advantage the fluid and solid non-hazardous organic material wastes' use for this purpose (Gulyás et al. 2012). Stefanovits (1970) and Mangwandi et al. (2014). The surface roughness can be examined by the shadow effects (Moreno et al., 2010). We examined under laboratory conditions the fermentation residues' improving effect on the soil structure. With mechanical interference we redound the formation tendency of the soil aggregates which evaluated by optical inquiry.

Materials and methods

For or study we choose two different type of soil. One is a humic sand originate from Gödöllő with high sand content (Arenosol) (Gulyás et al. 2014), the other is an alluvial chernozem from Mosonmagyaróvár (Fluvisol) (Table 1.). Each sample was 50-50 g of

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weight to which we add distilled water and biogas fermentation residues (digestate) in different ratios (Table 2.).

Table 1.. Parameters of the examined soils' (K_A: soil plasticity index, hy: water retention property)

Sample	Soil type	K_A	hy	humus%	$CaCO_3$%
Gödöllő	Arenosol	25	0.8	0.5	0
Mosonmagyaróvár	Fluvisol	38	2.5	2.7	27.4

Table 2. Treatments on the 50 g samples (DV: distilled water)

Sample	Control	Half dose of digestate	Full dose of digestate
Gödöllő	10 cm^3 DV	1.5 cm^3 digestate + 8.5 cm^3 DV	3 cm^3 digestate + 7 cm^3 DV
Mosonmagyaróvár	22 cm^3 DV	15 cm^3 digestate + 20.5 cm^3 DV	3 cm^3 digestate + 19 cm^3 DV

The fluid amount for the treatments (Gödöllő: 10 cm^3, Mosonmagyaróvár: 22 cm^3) was specify by granulation pre-trials. We made the granulation in a 5 dm^3 of capacity homemade rotating drum (Figure 1.), started with 50 g of air-dry sample, after we add the fluid for each sample. After the granulation we put the samples to open containers and we keep them intact for 2 days. We made photos from the air-dried samples around the vertical axis (at 0°,90°, 180°, 270°) while we illuminated them in angel of 45°. (Figure 2.).

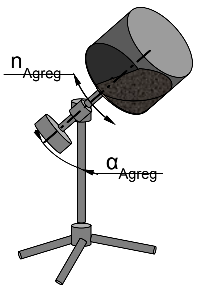

Figure 1. Rotating drum for granulation

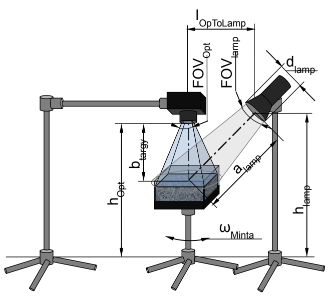

Figure 2. Making the photos

We crop the photos for the optimal size with Microsoft Office Picture Manager. We determined the pictures average luminosity by the IrfanView program's histogram function. To determine the luminosity value (%) we made a brightness correction on the photo in which we changed the original picture's brightening until it wasn't totally a white picture. For the evaluation we used a Visual Basic algorithm in Microsoft Office Excel which based on Sváb (1981). This algorithm has been successfully applied in several studies (Kovács et al. 2013, Szabó et al. 2013).

Results and discussion

During the rotation the light which comes from different angel reflect in different intensity. We calculated the average and the dispersion of the luminosity (%) for each sample in every measured angel. Per treatment we calculate the average variance too (Table 3.)

Table 3. Average variance of the difference luminosity values (%) (MQ)

Sample \ Treatments	Distilled water	Half dose of digestate	Full dose of digestate
Gödöllő	0.20	0.41	0.50
Mosonmagyaróvár	0.58	0.49	1.11

In the case of the Arenosol from Gödöllő the higher organic material (digestate) content increased the variance. The deviation between the 0.20 and 0.50 variance can be verify with Fisher F test with 7% The deviation of the variance between 0.20 and 0.41 can be verify just only 12% of error probability. The bigger variance caused by the light from different angels refer to bigger granulates (Figure 3.).

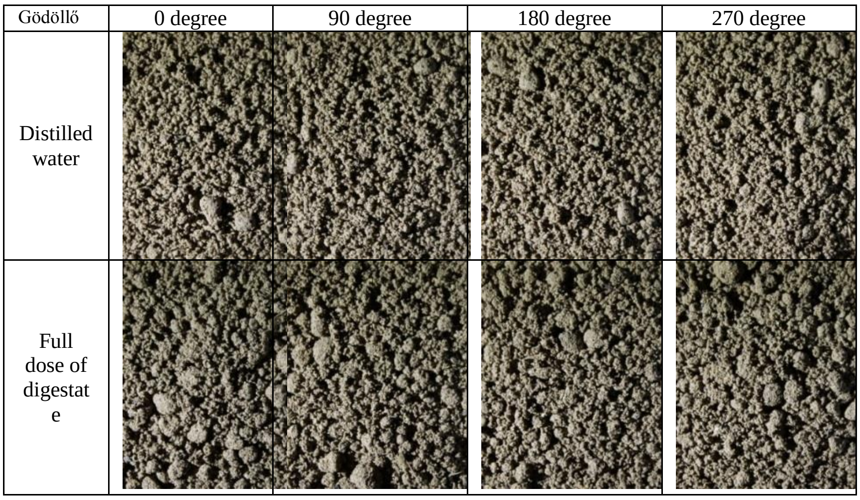

Figure 3. Arenosol from Gödöllő with distilled water and full dose digestate treatment, in different expositions.

In the case of the Fluvisol from Mosonmagyaróvár, the biggest difference was between the treatments of the half (0.49) and the full (1.11) dose of digestate' average variance. The deviation can be verified with only 9% of error probability (Table 3.). The effect of the 4 different exposure angel on the luminosities' average was evaluated by two-way ANOVA. (Table 4.).

Table 4. The samples' average luminosity difference (%) by the treatments

Sample \ Treatment	Distilled water	Half dose digestate	Full dose digestate	Soil average
Gödöllő	35.19	33.89	32.95	34.01
Mosonmagyaróvár	36.12	36.64	35.91	36.22
Treatment average	35.65	35.26	34.43	

The soil types considerably influence the average ($p<0.1\%$) of the luminosity (%). The samples from Mosonmagyaróvár has significantly ($SD_{5\%:}$ 0.54) higher luminosity average (36.22) than the samples has from Gödöllő (34.01). The treatments had considerable influence on the luminosities' too ($p<1\%$). The higher digestate treatments decreased the average of the luminosity. The significantly ($SD_{5\%:}$ 0.66) lowest average was at the full dose digestate treatment (Figure 4.).

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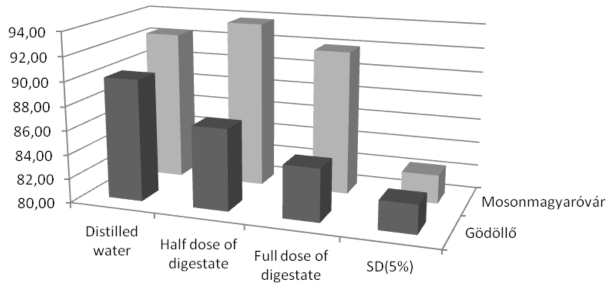

Figure 4. Observed average of the luminosity (%) for each treatment.

When the OM (digestate) content was higher in the samples from Gödöllő, the luminosity was decreased ($SD_{5\%}$: 0.93). It were not significant at the Mosonmagyaróvár samples. These results suggest that the Arenosol's originally low aggregate forming capacity can be improve by adding organic materials as digestate. At the Fluvisol sample from Mosonmagyaróvár, the aggregate former capacity is adequate without any treatment, and it is not increasing by adding more organic material.

Conclusions

Illuminate the soil's surface from different angels cause different reflections. This reflections made diverse shadow effects because of the soil aggregates and this effects can be measured from the top. Based on the shadow effects can be infer the roughness of the soil surface. Later the impact of the soil tillage can be evaluate by remote sensing.

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