



EU Joint Research Project "Characterization of fresh and deposited sludges of the Moscow region and development of strategies of a utilization in composting processes, agriculture or horticulture" ACRONYM: Composting Contract-No. ERBIC15CT980114

Partners: - H.-P. Schmauder, Research Centre of Medical Technology and Biotechnology (fzmb e.V.), Coordinator, Bad Langensalza, Germany
- V. F. Ladonin, G. Merzlaia, R.A. Afanasiev, All-Russian Research Institute of Fertilization and Agricultural Soil Science, Moscow, Russia
- J. Dlugonski, University of Lodz, Institute of Microbiology, Lodz, Poland
- J. C. Grün, S.A. Humus Innovation, Faulquemont, France
- E. Schiffner, K. Falkenberg, FAMA GmbH & Co. KG, Meiningen, Germany

Main Topics

Sludge in Moscow, produced annually in the amount of about 600 000 t is utilized mainly by placing on silt grounds and special areas. As the same time, a large part of sludge at the present time corresponds to the sanitary requirements, due to a decrease of industrial pollution of waste water and perfection of technology for treating waste water and can be used as a fertilizer. Today the sludge were pressed and dehydrated to 25% of dry mass. This material were deposited on special as well as usual deposits

On the other hand there exists a necessity for bringing in new organic matter into these soils.

The concentration of heavy metals is normally controlled by the plant owner. The usual concentration is in the range of the European standards and in some case up to 200% higher. The load of the sludge with organic waste compounds in the same way as the microbial, parasitological and virological status is not analyzed in detail up today. But such studies are absolutely necessary for a development of applications for the sludge and the composts produced on their basis.

The following tasks were set:

- to study ways to compost sludge with sawdust and other wastes
 - to study the effect of sludge and compost on the agrochemical and agroecological properties of soil
 - to establish the effect of sludge and compost on the productivity and quality of agricultural crops
- to develop a "simple technology for composting the fresh and deposited sludge applicable in the rural areas of the Russian Federation as a demonstration example for other partners in the world.

Main Results, Part 1 (Analysis of Sludges)

Chemical composition of sludge

Characteristic	Fresh sludge	Long-preserved sludge
Moisture, %	84,2	73,6
Dry matter, %	15,8	26,4
pH	6,9	6,9
In dry matter:	47,4	53,1
Organic matter, %		
Ash, %	52,6	46,9
N total	1,8	2,4
N- NO ₃ mg/kg	-	-
P ₂ O ₅ %	3,9	5,2
K ₂ O, %	0,16	0,22
C, %	23,7	
C:N	13	26,5
Cu, mg/kg	429	11
Cd, mg/kg	10	534
Pb	36	72
Hg	0,2	0,2
Cr	375	274
Ni	104	165
Mn	345	798
Zn	1672	1831
As	24	18

Weight of roots and ratio of above-ground biomass and biomass of roots of perennial grasses Under high doses of sludge applied

Treatments	Weight of roots, g/m ²	Above-ground biomass, g/m ²	Ratio of roots and above-ground biomass
Soil 100% (control)	494	375	1:1,3
Soil 75% + sludge 25%	542	534	1:1,0
Soil 50% + sludge 50%	819	637	1:1,3
Soil 25% + sludge 75%	1131	691	1:1,6
Sludge 100%	478	820	1:0,6

Effect of composting on the composition of compost mixtures traditional one and the one base on sludge

Characteristic	Compost based on peat		Compost based on sludge	
	Initial mixture	Compost	Initial mixture	Compost
pH	7,9	7,5	8,5	8,4
Moisture, %	68,1	32,2	65,8	31,4
In dry matter:	77,9	70,8	69,9	62,2
Organic matter, %				
Ash, %	22,1	29,2	30,1	37,8
N total	1,82	1,27	1,51	1,44
N- NH ₄ mg/kg	36	44	56	59
N- NO ₃ mg/kg	153	73	402	178
P ₂ O ₅ %	3,5	4,1	5,1	4,7
K ₂ O, %	0,12	0,14	0,19	0,26
C:N	22	28	23	22

Yield of dry mass of *Dactylis glomeratum*, average for 13 year in treatments with application of sludge from Moscow in ground

Treatment	Dry mass, g/m ²	Yield gain	
		g/m ²	%
Soil 100% (control)	416	-	-
Soil 75% + sludge 25%	471	55	13
Soil 50% + sludge 50%	569	153	37
Soil 25% + sludge 75%	590	174	42
Sludge 100%	701	285	68

Main Results, Part 2 (Composting and compost application)



Figure 1- 4. Compost process in running phase

Figures 5-7. Application of compost from sludges

Main Results, Part 3 (Composting strategy)

The most important advantage of such a compost plant in comparison to other techniques, e.g. tunnel composting; container box composting; pile composting done in closed buildings) are the lowest treatment costs of all techniques.

The typical input substrates are:

- Biosolids in the form of partly dewatered sewage sludge from either municipal waste water treatment plants or industrial wastewater treatment plants so far this waste water is acceptable for composting (solid content of sludges from 25 to 35 %)
- Carbon carriers in form of biodegradable materials like greenwaste, strictly segregate! yardware, any residues from logging and sawmill operations, pine park, barkpeelings, woodwaste, limbs scrubs grassclippings.

Processing phase

The components, delivered by either truck, barge and or railcar on the composting site are entering immediatly the composting process. They are mixed with a fronten-loader in the rough relation of two parts carbon carriers and one part biosolids. This relation can be varied, depending of the characteristics of both the carboncarrier:

- less or more wooden parts size of the parts, less or more soft materials like grass, leaves and the biosolids
- degree of dewatering resp. moisture content

The compost is formed to static piles with a base wide of about 6 m and a high of about 3 m. It stays in this form for a time of approximately 3 weeks. Within this period a vehement biochemical process takes place in the compost. Temperatures are rising up to 70°C. Mesophilic and thermophilic bacteria and fungi also decompose in their metabolic process mainly carbohydrates, organic acids and proteins and build up typical „compost substances“ at the same time take place a pasteurisation / hygienization of the compost.

The compost is than mixing - in the most cases by front loaders - for a newly high content of oxygen. This mixing process is repeating twice to four times. More is not necessary.

For the production of final compost goes through a 6 to 7 month during composting stage, where the temperature goes down slowly to the 30 ° C range. In this time new bacteria and fungi developing rapidly in the compost, turning it into the stage of maturity. Stable forms of humus are build now.

In this time the pile is turned up to 3 times.

After the phase the compost can now be sieved into various granulations ranging from 0 to 20 mm or even larger. The product is ready for application in the fields of agricultural fertilizing and landscape building / re-cultivation.

Results of the research work done: 3 papers in scientific journals, 16 posters and lectures