

Wastewater Treatment and Sludge Utilisation in Hungary

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Abstract: Hungary's accession to the European Union in 2004 marked the start of a new era. The completion of legal harmonization brought in new emission standards and thresholds, and this was followed by EU-assisted projects to build and reconstruct wastewater treatment plants. The utilization of sludge after it leaves the wastewater treatment plant is now a solely private-sector operation. There are new political priorities: increasing state involvement, buying out of major—formerly privatized—service providers, reintegration of isolated service providers, legally-imposed reduction of public utility charges. As a result, a demand has arisen for a greater central, i.e. government role in sludge utilization.

Key words: European Union, legal harmonization, utilization, sludge, political priorities, public utility charges.

1. Introduction

In Hungary, the political transition from the Soviet sphere of interest to the Western European community was closely linked with moves to join the European Union. The initial transition took place between 1989 and 1990. Formal accession to the EU took place only in 2004, but preparations and legal harmonisation started in the late 1990s. This paper analyses the effects of these processes and of events since then on wastewater treatment and sludge utilization.

Construction of the wastewater drainage network and treatment facilities did not keep pace with the development of the drinking water supply. Prior to the transition, 76% of homes were connected to the public water supply and only 41.3% to a public sewer. This gap has been greatly narrowed made up thanks to EU funding.

Nowadays, water supply connection is close to 100%. In 2013, the rate of wastewater drainage and treatment reached the figure of 82% nationwide, 8% of which did not involve connection to a public sewer.

This improvement has been concentrated in Budapest and the towns. By 2015, all towns and villages larger than 2000 PE must have a sewer connection and biological treatment. Since the Danube Basin – which includes the whole of Hungary – qualifies as a sensitive area, 80% of treatment works have nutrient removal capability.

2. Materials

The situation in villages smaller than 2000 PE, however, is less advanced. The means by which EU and national funding may be provided for these villages is currently being drawn up for the next 7-year planning period.

Hungary has a relatively large number of small villages. Villages with population of less than 2,000 make up 75.3% of all towns and villages and hold 17% of the population.

Young people, however, tend to move away from them owing to lack of local job opportunities. Effort is required in the coming period to provide wastewater drainage and treatment which is in proportion to these villages' abilities to sustain themselves.

The developments so far have resulted in water

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supply and wastewater charges which are beyond the financial means of much of the population. Research in this area has found that this is also true for the other utilities—gas, electricity and district heating.

Charges in Budapest in the last nine years.

Water: in 2005: $131.6 + 15\% \text{ VAT} = \text{HUF } 151.34/\text{m}^3$;

in 2014: $172.4 + 27\% \text{ VAT} = \text{HUF } 218.95/\text{m}^3$;

Increase: 44.67%;

Sewage: in 2005: $186.1 + 15\% \text{ VAT} = \text{HUF } 214.02/\text{m}^3$;

in 2014: $300.23 + 27\% \text{ VAT} = \text{HUF } 381.29/\text{m}^3$;

Increase: 78.16%.

In 2005, the total price for these services was HUF $365.36/\text{m}^3$; in 2014 it was HUF $600.24/\text{m}^3$, an increase of 64.28%. In other towns and cities, particularly small towns and villages, this can be 50-80% greater. The state currently subsidises households where charges are higher than 1,000 HUF/ m^3 . In 2013, the government required utility companies to reduce their charges by 10%, and the 2014 prices reflect this.

Incomes have not grown at the same rate. The rises in electricity, gas and district heating charges have made them among the highest in Europe, relative to income.

Fig. 1 shows the average burden of charges among households connected to both the water supply and

drainage in the service areas of different companies (water utilities). Each column corresponds to one company. The burden of charges for the two services together varies between 1.5% and 3.5% of income. For most companies, the figure lies between 2% and 3%, which is under the frequently-published threshold of 3-4.5%, but is considerably above the 2004 Central European average of 1.6-1.7% [1].

Disposal of wastewater sludge has not been included in waste management development projects. Thus even after the construction of Budapest's Central Wastewater Treatment Plant and a nationwide increase in sludge of nearly 30%, no solution has been found for its disposal. Transport over long distances greatly increases the costs of disposal and, indirectly, the sewage charge.

The new wastewater treatment plants built in cities other than Budapest have added biogas production to their sludge treatment, from which they generate electricity. In most of these plants, the sludge is further treated by composting. Ways of using the resulting compost, however, did not emerge alongside the developments. Compost should be sold on the open market, but sales problems have caused large quantities to accumulate at many sites. The licensing authority does not have information on the amount of

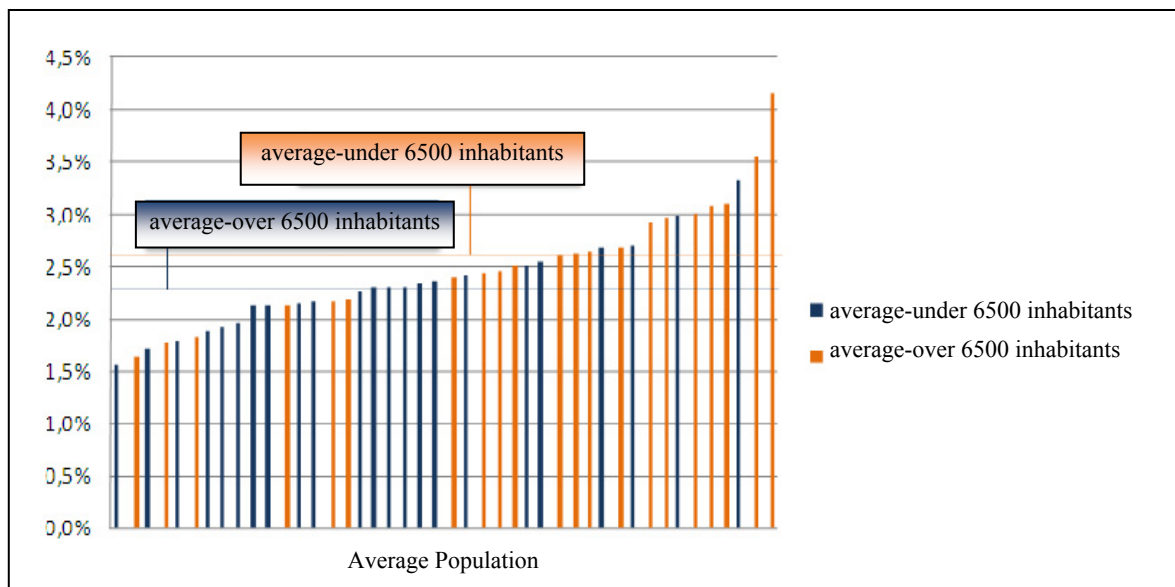


Fig. 1 Water charges as a proportion of income in towns with both services, by average population, 2009 [1].

compost sold. A serious question is whether the high costs of composting are justified purely for stabilising the sludge if there is no market for it.

The use of sludge for energy purposes in Hungary at present goes no further than producing biogas. Wastewater plants produce some 100,000 m³/d of biogas, generating 9.2 MW of electricity. This procedure is attractive as a means of reducing operating costs. It has a negative effect, however, on further energetic use, i.e. on incineration. Not surprisingly, such utilisation does not exist for communal sludge in Hungary. The figures are little better for communal waste as a whole: only 5% of the present 18 million tonnes of waste is utilised in this way, falling far short of the other EU member states.

The direct agricultural use of sludge is described below. This form of utilisation involves sludge which has been treated in some way and is deposited on designated land. It does not include compost sold on the open market.

Fig. 2 shows a decrease in the amount of sludge

deposited in the last 13 years, at the same time as wastewater treatment developments have resulted in increasing total quantities of sludge. Other figures show that the amount of sludge deposited per unit area has also decreased by 30% in the same period, so that the efficiency of disposal has also deteriorated.

3. Results and Discussion

There are several reasons why agricultural utilisation has declined. The conditions of depositing it have become much stricter. The Table 1 shows the change of permitted heavy metal content of sludge used for agricultural purposes in the last 25 years. EU regulations are expected to become even tighter. Thresholds will also be set for organic constituents, and this will impose further restrictions. In the 1990s, following the political transition, Hungary met the thresholds for sewage sludge set by EEC Directive 86/278. EU legal harmonisation set off a process of tightening the rules, as shown in Table 1.

The EU member states apply the restrictions on

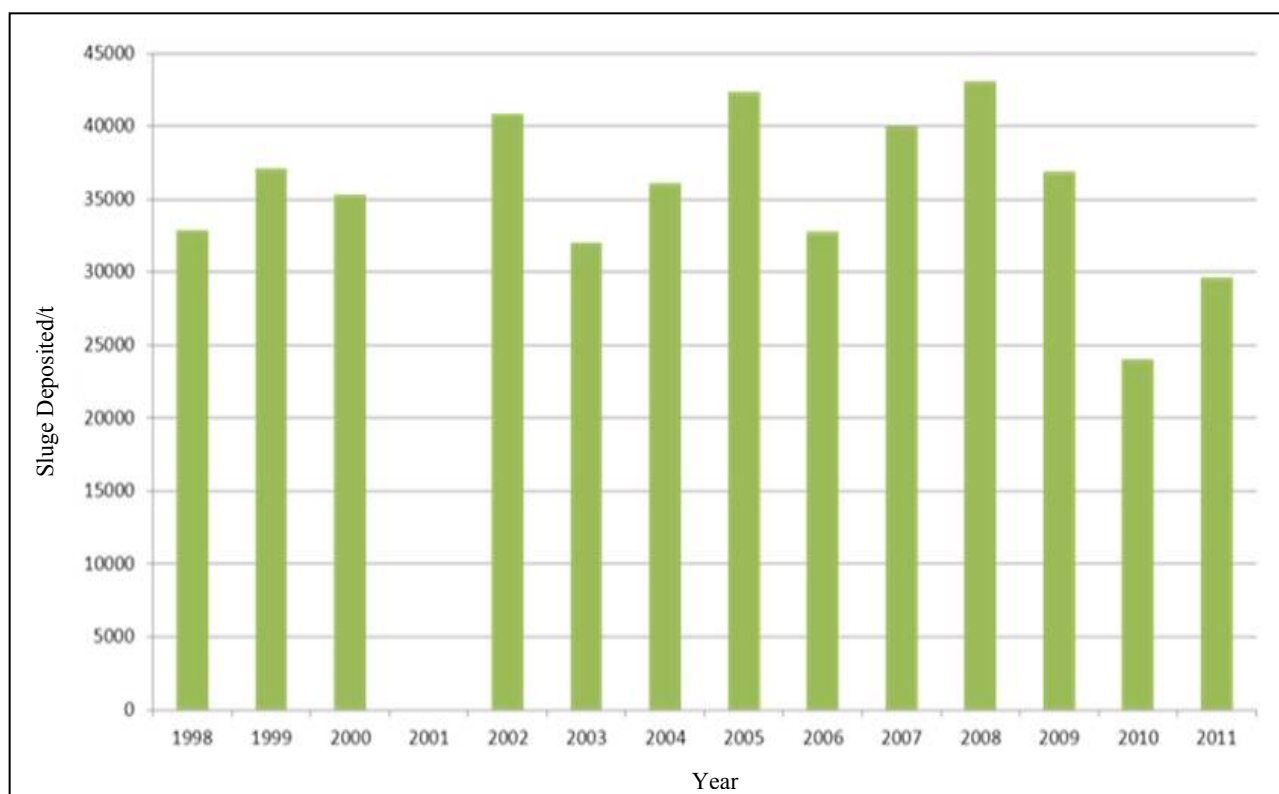


Fig. 2 Trend of agricultural use of sewage sludge in Hungary [2].

Table 1 Concentration limits for toxic elements in sewage sludge [3].

Heavy metal mg/kg dry matter	Former hungarian limits (1990)	86/278 EEC	Current hungarian limits (50/2001. Korm. rend.)	Planned hungarian and EU limits (2016)
Cd	15	20-40	10	0,8
ΣCr/Cr VI	-	-	1,000	100
Cu	1,000	1,000-1,750	1,000	1,000
Ni	200	300-400	200	30
Pb	-	750-1,200	750	120
Zn	3,000	2,500-4,000	2,500	2,500
Hg	10	16-25	10	0,8
ΣPAH	-	-	10	3
ΣPCB	-	-	1	1
TPH	-	-	4,000	4,000
Mo	20		20	20
As	-		75	75
Co	-		50	50
Se	-		100	100

toxic elements in different ways, and the overall picture is highly varied. Figs. 4-5 show the toxic element threshold values in EU states.

Figs. 4-5 show that Hungary occupies a middle position as regards the strictness of thresholds. A new decree, however, will require further tightening to be introduced in 2016.

Austria is an interesting case. In the fertile Burgenland in the eastern part of the country, the thresholds for some elements are 4-5 times higher than in Lower Austria.

Reduction of thresholds for toxic elements is also an aim for EU regulation. Research in Hungary, however, has found that agricultural utilisation of wastewater sludge has no toxic effect on soil if used in the prescribed doses [4, 5].

Other examinations show the reduction of heavy metals in sludge, results are presented on Fig. 6.

Other studies have shown that wastewater sludge has a beneficial effect on the microbiological activity of soils [6].

Another factor which has contributed to the declining trend of agricultural sludge utilisation is the change of land ownership: land formerly run by large socialist enterprises was sold off and broken up into parcels.

The consequences of this process on sludge utilisation in Hungary may be characterised by analysis of utilisation costs. Surprisingly, these—without energetic utilisation of the sludge—match or surpass sludge utilisation costs in Germany (Fig. 7).

The highest mono incineration costs in Germany are less than € 400 per tonne-dry matter, while recultivation costs in Hungary are more than € 550 per tonne-dry matter.

As a basis for comparison of disposal costs, we used the data of the German federal environment protection office [7].

New, patented techniques for improved sludge utilisation have resulted from research and development in Hungary over the last decade.

One example is the Lignimix process:

The main innovation in the process is wet grinding (shearing) of municipal sewage sludge (or liquid manure) to which carbonaceous minerals (lignite or brown coal) have been added. The resulting radical mechano-chemical impingement converts the sludge into a stable suspension.

Powdered lignite is added to sewage sludge of 5-6% dry matter, and the mixture is continuously subjected to shear stress in a wet grinder (Kavitron).

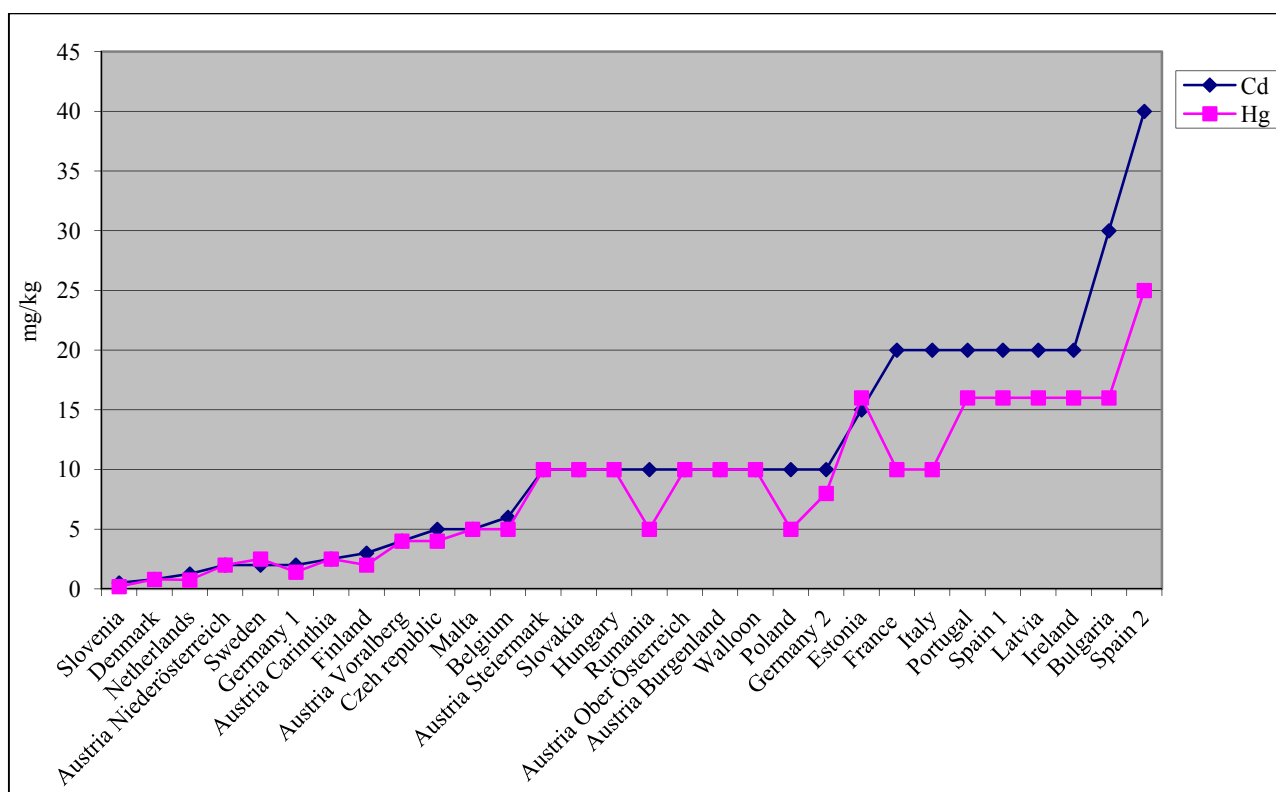


Fig. 4 Limits for Cd and Hg content of sewage sludge for agricultural use in the EU (mg/kg) 2010 [2].

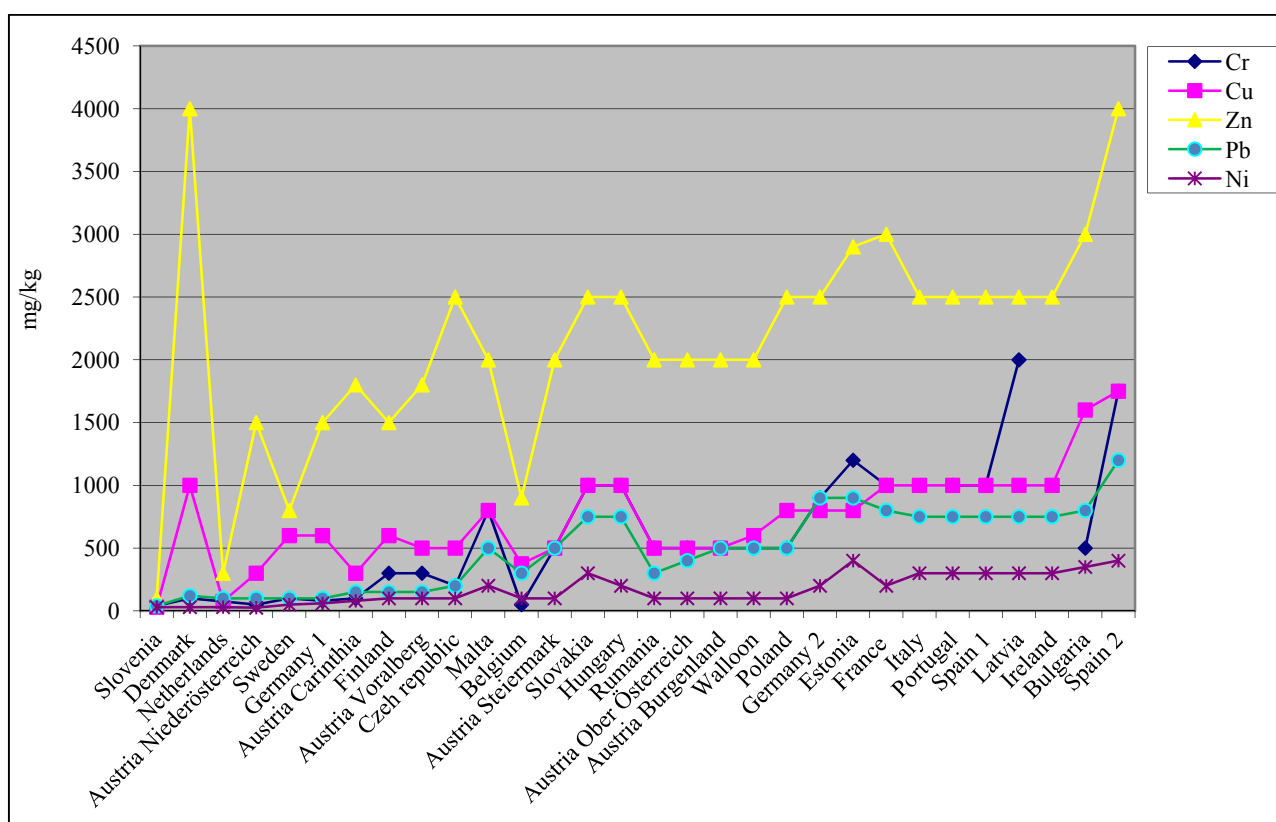


Fig. 5 Limits for Cr, Cu, Zn, Pb and Ni content of sewage sludge for agricultural use in the EU 2010 [2].

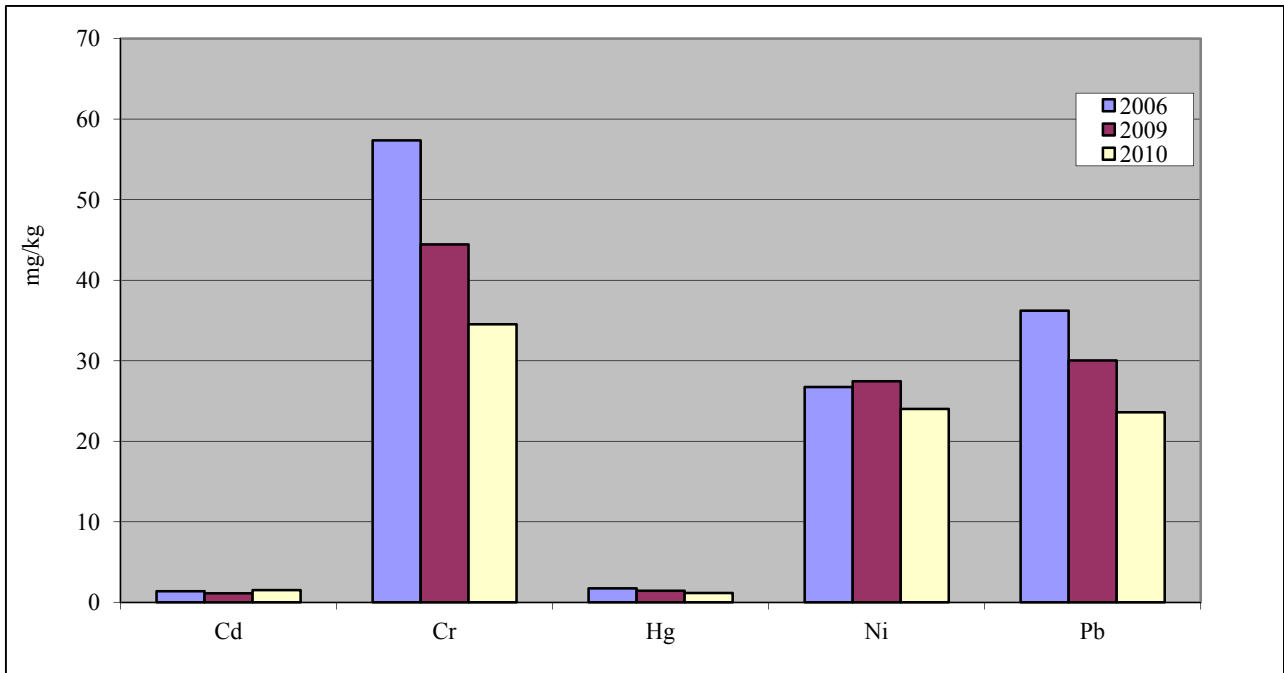


Fig. 6 Changes of heavy metal content in sewage sludge in Hungary [2].

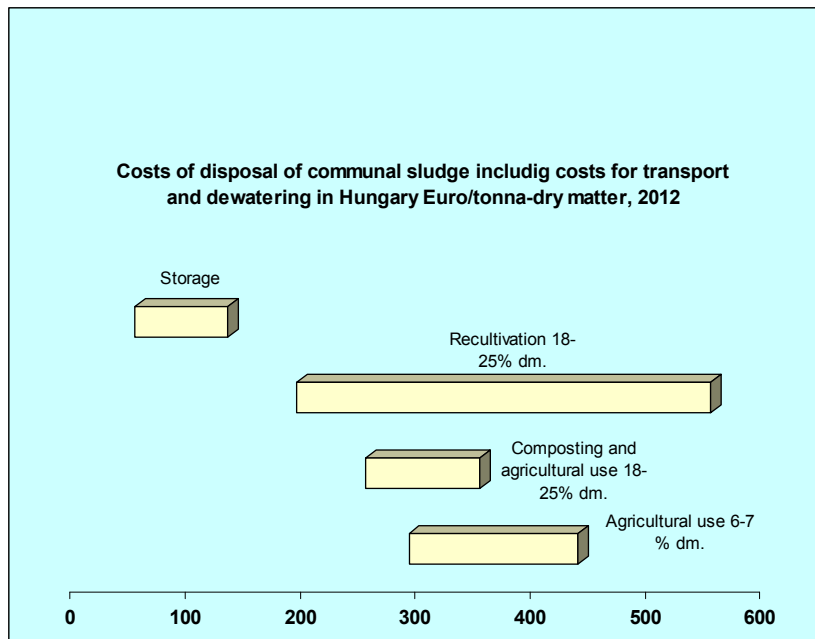


Fig. 7 Costs of disposal of communal sludge, including costs of transport and dewatering in Hungary. €/tonne dry matter, 2012 [8].

Positive changes in sludge treatment:

- Lignite disintegrates and forms a homogeneous suspension with the sludge;
- The suspension immediately loses most of its bad smell;
- When the suspension fully dries, its pathogen

count falls by 2 to 5 orders of magnitude;

- Desiccation occurs fast and uniformly;
- The dry matter obtained (70% or less water) becomes stable (e.g. no rotting. no changes in properties).

Utilisation of LIGNIMIX:

- Fuel: burns exactly as brown coal;
- Soil conditioner: a more promising application due to valuable ingredients recycling into the soil;
- Lignite suspensions gradually undergo complete humification;
- The wet suspension can yield up to 20% more biogas than sludge treatment by putrefaction [9].

4. Conclusions

(1) Sludge utilisation makes up a substantial proportion of wastewater treatment costs: as much as 40-50%. The choice of treatment technique is thus very important, and must harmonise the possibilities with the demands.

(2) Sludge treatment should be managed at the level of national strategy. Free-market elements that inhibit rational and economic utilisation should be eliminated.

(3) A balance should be struck between agricultural and thermal utilisation. Thermal utilisation should be increased at the expense of expensive and less efficient recultivation utilisation.

(4) Each member state should find the sludge utilisation method that best suits its needs and capabilities. Sludge treatment at the wastewater works and utilisation elsewhere must be viewed and planned as an integrated process.

(5) Future regulation of toxic elements should be made consistent with the capacity of differently-endowed agricultural areas to ensure

efficient agricultural utilisation.

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