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ANALYSIS OF ASH LANDFILL IMPACT ON SURROUNDING MINE AND WATER

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ABSTRACT
The main aim of this paper is to form a stabile and safe ash and bottom ash landfill in approved space inside mining, and to secure landfill from negative influence of water which may appear inside mining, and also to prevent spreading of eventualy contaminated water from landfill. In order to approach these activities it was necessary to define space for starting and later to form ash landfill according to positive acts of mining.
In this paper the results obtained by monitoring the quality of surface and groundwater at the existing ash and bottom ash landfill that services the thermal power plant.
Measurements are scheduled as to provide the results on water quality prior to the start up of hydraulic transport and disposal. After start up, continuous monitoring of water quality is planned.
Usage of technology of ash preparation, transportation and deposing is based on original and patented technology.
Key word: thermal power plant, ash, bottom ash, landfill

1. INTRODUCTION
The area designated for the future ash landfill is positioned in the depression of the open pit mine. This may have a rather unfavourable impact on the surrounding area considering the dissipation of dumped ash (polluting workings with fine particles of ash and bottom ash) and contamination of mine waters (which are collected and discharged into the nearby river). In order to prevent this situation it is necessary to adapt the hauling technology to given circumstances. The application of ash and bottom ash self-solidification technology is an excellent example of successfully set technology. Considering that this technology has been already efficiently applied in the existing landfill the available results obtained may be used for analysis.
Numerical data on air pollution levels at the hydraulically formed landfill are not available, but on the basis of a subjective observation it may be affirmed that air pollution at this landfill practically does not exists. Figures 1 and 2 show difference in air pollution is obvious when applying dry or hydraulic disposal technologies.

Figure 1. Details showing dry ash disposal with spreader

Figure 2. Details showing hydraulic ash disposal at the existing landfill nearby thermal power plant

Solidified ash deposited on the floor seam composed of clay formations of thickness ranging from 100 to 300 m practically has no impact in groundwater since clay is a natural hydrogeological aquifuge. Regardless of this fact it is worthwhile to consider the measuring results obtained on the basis of ash landfill impact analysis on surface and groundwater in the surrounding area quoted from the previously mentioned article. It should be taken into account that the existing landfill is located within the alluvion of the river and that this location is far more difficult for protection against contaminated surface and groundwater than the newly selected location in the available space of the open pit.

2. QUALITY MEASUREMENTS OF SURFACE AND GROUNDWATERS AT THE EXISTING ASH AND BOTTOM ASH LANDFILL THERMAL POWER PLANT

Groundwater has been sampled from specially constructed piezometers (4 altogether) and surface water from adjacent drainage ditches (6 measuring points altogether). Measurements are scheduled as to provide the results on water quality prior to the startup of hydraulic transport and disposal. After startup a continuous monitoring of water quality is planned.

Results of surface water quality measurement from ditches that surround the landfill prior to the startup of the new disposal technology (measurements performed over the period between November 1996. and February 1997.) and after startup (measurements performed over the period between March 1997. and March 1998.) are shown in the table 1.

Table 1. Quality of surface water from ditches that surround the landfill prior to and after the startup of the new transport and disposal facility

Parameters	Measurements prior to hydraulic disposal			Measurements after hydraulic disposal startup				MCL
	XII 96.	I 97.	II 97.	IV 97.	VII 97.	X 97.	I 98.	
pH values	8,0-8,3	7,1-7,8	7,6-7,7	8,5	8,15	8,2	8,1	6-9
Dissolved oxygen, mg/l	7,8-8,8	8,8-9,5	9,7-11,3	11,4	6,41	7,6	8,6	3
BOD, mg/l	0,6-3,9	1,1-1,4	1,7-7,4	1,93	3,5	2,6	1,0	20
COD, mg/l	3,1-3,6	4,0-8,9	3,5-10,7	4,0	2,5	4,3	5,2	40
Carbonates, mg/l	0	0	0	0	0	0	0	-
Bicarbonates, mg/l	140-201	140-213	103-281	85	85	85	122	-
Sulphates, mg/l	81-117	76-150	64-97	94	33	58	105	-
Chlorides, mg/l	41-59	25-130	35-95	28	25	21	34	-
Nitrates, mg/l	2,7-9,1	3,1-9,0	3,6-4,5	2,26	0,9	2,26	3,2	15
Nitrites, mg/l	0-0,12	0,12	0-0,54	0	0,18	0,06	0,12	0,5
Lead, mg/l	0,007	0	0-0,017	0,032	0,022	0,027	0	0,1
Cadmium, mg/l	0	0	0	0	0	0	0	0,01
Zinc, mg/l	0,025-0,25	0,03-0,04	0,015-0,02	0,022	0,002	0,025	0,012	1
Nickel, mg/l	0-0,01	0	0-0,032	0,020	0	0,007	0,02	0,1
Manganese, mg/l	0,02-0,06	0,01-0,06	0,01-0,032	0,027	0,007	0,007	0,045	-
Chromium, mg/l	0	0	0	0	0,015	0	0	0,1
Iron, mg/l	0,15-0,16	0,04-0,11	0,05-0,16	0,067	0,050	0,007	0,047	1
Phenols, mg/l	0-0,002	0-0,018	0-0,001	0	0	0	0,003	0,3

The results obtained show that there is no aggravation of surface water quality in the landfill area. Detailed analysis indicates to slight increase of pH value. A rather insignificant increase of lead ions is also noticed, although its presence has not been recorded in any of the dry ash analyses. It is highly possible that this lead originates from other sources since the ditches that surround the landfill discharge all the wastewaters that flow from the coal-fire power plant. The content of all the analysed heavy metals is within allowable rates and for that matter no impact of the landfill has been recorded.

The quality of groundwater has been monitored by means of four piezometers distributed around the ash landfill. The results of water quality measurements obtained from these piezometers are presented in table 2.

Table 2. Groundwater quality obtained from piezometers surrounding the ash landfill prior to the startup of the new transport and disposal facility

Parameters	Measurements prior to hydraulic disposal			Measurements after hydraulic disposal startup				MCL
	XII 96.	I 1997.	II 1997.	IV 1997.	VII 97.	X 1997.	I 1998.	
pH values	7,2-7,7	7-7,35	7,3-7,6	7-7,15	6,8-7,6	6,2-7,5	7,2-7,8	6-9
Dissolved oxygen, mg/l	3,0-4,1	3,26-5,39	3,6-5,1	1,7-4,9	1,5-4,4	6,7-8,5	2,0-3,3	3
BOD, mg/l	1,0-2,2	1,5-3,63	1,5-4,0	1,3-3,3	1,4-3,5	1,8-6,5	1,4-2,6	20
COD, mg/l	4,6-15,0	7-16,8	6,8-18,8	9,6-24,6	9,7-35,1	7,5-28	6,1-10,6	40
Carbonates, mg/l	0	0	0	0	0	0	0	-
Bicarbonates, mg/l	427-622	213-640	140-634	122-658	432-579	512-646	524-640	-
Sulphates, mg/l	343-794	257-934	352-1019	403-889	278-981	294-1082	223-752	-
Chlorides, mg/l	13-39	9-43	28-49	30-100	35-54	30-61	29-46	-
Nitrates, mg/l	0,45-4,52	0,45-1,8	0,45-2,71	0,9-3,16	0,45-1,39	0,9-1,8	0,45	15
Nitrites, mg/l	0-0,9	0,06-0,12	0,06-0,54	0-0,18	0,01-0,18	0,06-0,12	0-0,06	0,5
Lead, mg/l	0-0,02	0-0,007	0-0,04	0,04-0,09	0-0,067	0,04-0,055	0-0,007	0,1

Cadmium, mg/l	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0,01*
Zinc, mg/l	*0,02-0,04*	*0-0,13*	*0-0,027*	*0-0,127*	*0-0,03*	*0,037-0,08*	*0,03-0,06*	*1*
Nickel, mg/l	*0,01-0,05*	*0-0,045*	*0-0,09*	*0-0,05*	*0-0,01*	*0,015-0,04*	*0,012-0,04*	*0,1*
Manganese, mg/l	*0,03-1,98*	*0,22-2,8*	*0,08-3,78*	*0,45-4,4*	*0,08-1,68*	*0,012-2,55*	*0,117-2,6*	-
Chromium, mg/l	*0,01-0,02*	*0-0,02*	*0-0,015*	*0-0,017*	*0-0,014*	*0-0,017*	*0-0,022*	*0,1*
Iron, mg/l	*0,08-0,73*	*0,1-3,7*	*0,1-0,192*	*0,48-1,72*	*0,13-0,42*	*0,032-0,33*	*0,095-0,23*	*1*
Phenols, mg/l	*0-0,005*	*0-0,013*	*0-0,022*	*0-0,006*	*0-0,004*	*0-0,001*	*0-0,001*	*0,3*

Analysing the results obtained it may be noticed that the switch to the ash solidification system had no effect on the quality of groundwater. Unlike surface waters, where a slight increase in pH values is recorded, the pH value of groundwater remains the same and no changes in relation to the previous condition have been registered whatsoever. A slightly higher content of chlorides has been recorded, although their exact source is not known. The content of heavy metals ions are below the maximum contaminant levels (MCL) stipulated by standards.

3. CONCLUSION

Therefore, on the basis of the results obtained by monitoring the quality of surface and groundwater at the existing ash and bottom ash landfill, that services the TPP it may be concluded that the technology of dense slurry disposal has no additional harmful impact on the quality of these waters that belong to the alluvion of the river. In line with the previous facts it may be affirmed that no changes in water quality should be expected in the newly designated location within the available space of the open pit mine.

The worst-case scenario that may occur during disposal is the landfill slide slurry outflow. In order to prevent this situation the solidification technology has been chosen. This technology excludes the possibility of landfill collapse due to slide of dumped material. Collapse of the landfill caused by the tumbling of solid body (which the solidified landfill in fact is) is highly unlikely unless provoked by seismic activity of catastrophic dimensions. The outflow of unbounded or weekly bounded slurry (either by flowing over or breaking through the embankment) is possible but it is also one of the main reasons for the suggested daily replacement of the active cell. This will largely contribute to faster solidification and in case of some disturbances, the amount of unbounded slurry is so rare that the damage can be considered as negligible. Leakage of water through the embankment is also possible, but proved water-unsaturated condition of dumped ash and the new, additional fringe ditch provides protection against the leakage of percolating water outside the landfill area.

4. REFERENCES

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