# DISPOSAL OF THERMAL WASTE USING UNDERWATER TECHNOLOGY AT ASH AND SLAG LANDFILLS

Expert Paper
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**Abstract:** *Resolving the problem of delayed material dispersion at ash and slag landfills using a water mirror (lake) has created another issue during material deposition due to the formation of a large water mirror surface and the considerable depth of the lake itself. The dense hydraulic mixture encounters an obstacle upon contact with the water mirror at the landfill, resulting in uneven filling of the underwater space and the formation of significant depth within the lake. One of the solutions to such problems is presented in this paper, using the example of the ash and slag landfill of the Nikola Tesla "B" Thermal Power Plant (TENT B), which involves the installation of a movable floating discharge pipeline across the surface of the lake.*

**Key words:** ASH AND SLAG LANDFILL, FLOATING PIPILINE, UNDERWATER FILLING

## INTRODUCTION

Ever since they were put into operation, in all thermal power plants in Serbia ash and clinker have been deposited hydraulically as hydro-mixture (an exception is the new power plant in Kostolac, Block B3, where disposal is carried out using belt conveyors, i.e. mechanical transport). Until 2008, the technology of ash removal with ejectors for electrofilter ash, and hoppers for boiler ash, was applied, along with internal transport to the basin at the pump station using basalt channels, and then through pipelines with an slurry pump to lagoon-type ash landfills. The characteristic of this technology is the use of a large amount of water, and the disposal of ash is carried out through free settling in the formed settling lake [1].

The Kostolac B and Nikola Tesla B thermal power plants reconstruct their systems of treatment of ash and clinker, they introduce dry deashing and storage of ash in silos. This enables the formation of thick hydro-mixture of ash and clinker, and its transportation to the ash landfill. The characteristic of this technology is the

use of significantly smaller amount of water, significant reduction of energy for transportation and significantly better geo-mechanical properties of the deposited ash and clinker. In terms of stockpiling, it is important to notice the difference that stockpiling is no longer done by free depositing, but rather the ash and clinker are deposited over one another in thin layers. This results in the formation of ash near the fill from which stockpiling is performed, and the lake which is continuously growing with the landfill remains non-filled.

This phenomenon is negative from two aspects:

- Uneven filling of landfill space and faster growth of the landfill;
- Deep lake has a more unfavorable impact on the process of drainage within the system of landfill dewatering.

For these reasons, a solution is proposed according to [2] that will allow for more even filling of the lake with an area of about 100 hectares in the operational cassette. The designed system is an addition to the existing system and it can be turned on and off by the operator on the landfill during the operation of the existing system.

## BACK-FILLING TECHNOLOGY

The applied technology of stockpiling by decanting of the thick hydro-mixture of ash and clinker does not enable the filling of the entire surface of the active cassette, since there is a lake in the middle of the cassette which takes up 60% to 70% of the total surface of the cassette where there is no significant filling with ash and clinker. The lake is intentionally formed in order to maximally decrease the exposure of the surfaces of the stockpiled material of the active cassette to wind, which causes it to be carried away and scattered to the surrounding area. Since the lake will exist on the active cassette as long as it is used for disposal of ash and clinker, a special technology is intended for filling of the unused space underneath the surface of the lake. This technology takes into consideration the impossibility of a more significant spillage of materials which is deposited underneath the water surface, that is, the characteristics of the material which is deposited under water to form significant steep slopes from the point of unloading underneath the surface towards the center of the cassette. Considering that it is not possible to fill in the space underneath the lake from one point on the largest surface, the solution must be the floating system, whose unloading points will be moved more frequently and lead to the special place for even filling of the space underneath the surface. Figure 1 shows the scheme for the disposal of ash and slag from the floating discharge system.

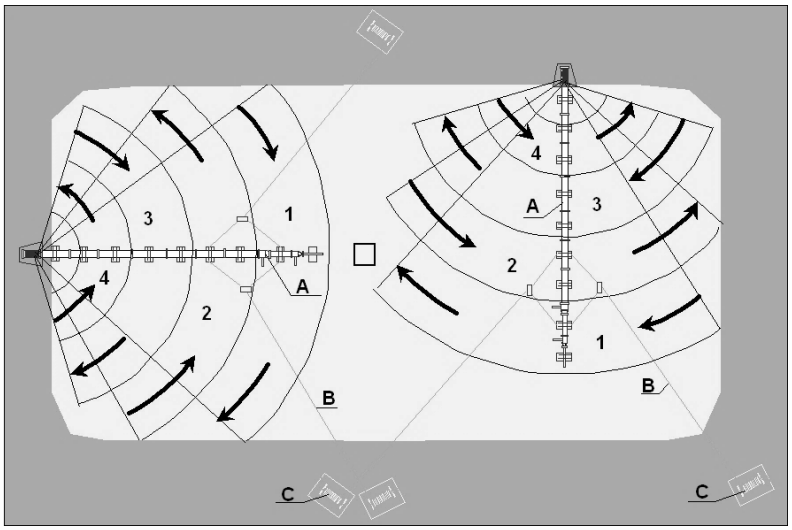


*Figure 1, Scheme for filling the space with elements of the floating discharge system; A – HDPE pipeline on pontoons; B – Steel cable; C – Winch; 1-4 designated filling zones;* [1]

FLOATING FILLING SYSTEM

Unloading pipeline can be connected to any distribution pipe around the cassette instead of one of the existing unloaders. It contains the overhead part of the pipeline which is placed around the terrain (beach), flexible pipe which enables turning of the floating part of the pipeline in relation to the fixed overhead part of the pipeline. The overhead and floating decanting pipeline is comprised of HDPE pipes, transportation and stockpiling. These pipes experience significant thermal expansion when hydraulic mixture does not flow through them, but the thermal expansion did not affect operation, as the pipeline was not rigidly fixed at the end.

POSITIONING OF THE UNLOADER IN THE LAKE

Even filling of the landfill space underneath the surface of the lake is faced with two basic problems:

- The filled space underneath the surface of the lake is no longer visible and
- The floating HDPE pipeline is flexible, so in case of disposal of the hydro-mixture or in case of

wind, the unloading point can be moved during operation.

The space which is filled in is not visible, so stockpiling will be performed according to the previously prepared plan and with regular control of the depth, that is, the achieved level of filling near the unloading point. When the space in front of the unloader is filled in until the depth of 1 m underneath the surface of the lake, the unloaders are moved to the next planned position.

The problem of the flexibility of pipes and moving of the unloading point is solved by connecting the end of the unloading pipeline to fixed support with plaited steel ropes. Fixed support are two platforms on which there are two winches for wire-winding with a built-in safety brake. Supports are built on the material landfill near the lake which is positioned in such a way so as to continuously tightens the pipes towards the unloading points. In this way, the pipeline is fixed with three connecting points, where the third connecting point is the end of the overhead pipeline [3].

*Figure 2, Discharge pipeline on pontoon supports showing the discharge of hydraulic mixture in operation (Photo by Goran Đotunović)*

PONTOON SUPPORTS

Pontoon support is formed by connecting two pontoons shown in the figure 3. Pontoons are made of UV-stabilized polyethylene pipes filled with styropor flange adaptors in its entire volume. Parallel openings are drilled in the pontoons per diameter in to spots. HDPE pipes are placed through them and they are welded to the coating of the pontoon. Through the formed turning piece, a galvanized pipe is inserted. Between the pontoons an outstrip is placed, a part of the HDPE pipe with diameter of adequate length which determines the position of the pipes between the pontoons. Pontoons and pipeline are tied by a chain.

*Figure 3, Installation of the discharge pipeline on pontoon supports (Photo by Goran Đotunović)*

WINCH FOR WINDING OF THE STEEL CABLE LOCK

The constructed winch is intended for moving the floating decanting pipeline over the surface of the water on the landfill of ash and clinker TEHT B. A pooling steel rope is connected to the floating pipeline on both sides, which is attached to the winch through the water and ash where it winds and unwinds as needed. The appearance of the winch is shown in figure 4. Winch is a metal construction with manual drive. It contains: CHC reductor, handle for manual turning of input mandrel of the reductor, coupling, drum for wire-winding, fixed dip of the drum mandrel, metal loadbearing construction made by welding of UNP profile, metal footing for connecting to the base.

*Figure 4, Installed position of the winch at the landfill (Photo by Goran Đotunović)*

Vessel for control, assembly and disassembly of the floating system

For assembly and disassembly of the pipeline in the water, intervention on the pontoons, for control of the pipelines, transportation of pipes with pontoons, monitoring of filling in the lake, a separate vessel is intended – catamaran. In this case, the catamaran is made of two circular pontoons, interconnected by a grid-like steel structure. The dimensions of the catamaran are 5x2.2 m at the base.

## CONCLUSION

With the successful implementation of the solution according to the new technology for filling the space below the surface of the lake at the ash and slag landfill, the following was achieved:

- Filling of unused space in the landfill
- Slow down the dynamics of the construction of the slope due to a more even filling of the active cassette
- Lower the possibility of water spillage into the slopes of the cassette, from the aspect of stability

## LITERATURE

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