

# Dumping of Communal Waste in the Course of Mining

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## **Abstract**

Smaller open pits, which are common in Croatia, can be used for sanitary dumping of communal waste. The volume of successively excavated mineral resources (such as clay, coal, gypsum etc.) can be filled in by waste and the sterile excavated masses of either the overburden or interburden – soil, clayey interbeds or other fine-grained fractions, can be used to cover the waste. After filling in the quarries with waste and overburden, the original landscape can sometimes be restored. The available mining machinery can be fully utilized in waste re-loading and dumping as well as the manpower and supervisory services. This activity could be a source of additional income for the mine, especially when costs of the area/volume used are calculated, together with the costs of covering the waste with overburden material, as well as the machinery, manpower and supervision. All of the mentioned components have to be validated in order to complete the process safely and in time. Multiple effects could be achieved in this way. The waste is completely removed from the landscape, the less dense components of the waste (paper, plastic etc.) can't be blown away, and the self-heating process is suppressed. Also, there is no air pollution, and the groundwater and soil can be protected as well, with additional protective measures taken in accordance with the material and properties of the surrounding rocks. The testing object is an active clay pit in eastern Croatia that produces approximately 100,000 m<sup>3</sup>/yr, which are used in a brickyard. The mine also excavates a quantity of 30,000 m<sup>3</sup> of overburden and interburden. There is a plan to dump approximately 20,000 m<sup>3</sup>/yr of communal waste, in the course of daily mining operation. To this purpose, a system of the cassette waste dumping with the regulatory protective measures is planned. Finally, a sport-recreational complex could be built on the site, because the mine is in close vicinity of a town with 50,000 inhabitants.

## **INTRODUCTION**

The principle of surface mining is to remove the overburden and then to excavate the mineral raw material. The operations at a surface mine and at a waste dump are of the same character, but with inverse purpose, the mineral raw material masses are not excavated, but the waste is put under the Earth surface. A number of coincidences occur in the course of the preparation, current and final works, and the optimal duration of the entire operation is the same (over 25 years). There is a number of similar problems that have to be dealt with – protection of the surface- and groundwater, degasification (removing of the CBM from the mine or of the biomass decomposition gasses from the waste dump), geomechanical conditions in the open pit (workbenches and final surfaces, terrain subsidence at overburden dumps and at the waste dump as well, recultivation of the affected areas etc. That is why it is necessary that mining engineers study these types of problems more frequently and enable the usage of abandoned mines for dumping of waste and reshaping of the

devastated areas. Such operations could be efficiently included in the work of the existing open pits, and especially well incorporated in the plans for opening and development of the future surface mines. This paper is a contribution to this kind of attempts in Croatia.

## **BASIC CONCEPT**

It is intention to incorporate the waste dumping in an ongoing mining operation (Fig. 1) and to achieve the multiple effects [1]:

- the available excavated areas that were formed by development of the mining works in the course of exploitation present the valuable space for storage of the waste masses, and this is nowadays sometimes hardly obtainable,
- the additional waste material that is permanently created in accordance with the number, size and intensity of the producers, can be used to fill the newly-formed excavations in the continuity of the mining process,

- the overburden and interburden sediment masses are separated from the raw material and dumped. This is usually unconsolidated material – soil, small fragments of earth and rocks, clay material and it can be fully used to cover the waste,
- in operations where the non-metallic mineral raw materials are excavated (clay, gypsum, stone etc.), the overburden ratio is rather small (5-30% of the ore masses), which means that a significant space remains available for the waste with the overburden masses that are just enough for the internal and final cover of the waste,
- emplacement of the waste masses in the excavated areas facilitates the final shaping of the area affected by mining – restoration of the initial terrain or some new facilities (sport & recreational areas),
- the equipment and technology that was used for removing of the overburden and excavation of the mineral raw material is already available and can serve the needs of the waste dumping part of operation, and
- the entire man-power of the mine, either directly working with the machinery, or planning and supervising the surface mine can additionally be better used in the waste-dumping activities.

Additional effects are achieved by combining the two operations in the course of mining. The waste can be covered promptly which results in [1]:

- fast removing of the waste from the sight, which is very important because the location of the waste dumps are generally rejected in public not only because of their existing ugly shape but also because their projects are not always consequently carried through completely. Connection with an ongoing mining operation could significantly reduce the public doubts,
- the less dense parts of the waste can't be blown away by the strong winds and are therefore not dispersed in the surroundings,
- birds, rodents and other animals cannot reach the waste material, which contributes to prevention of the contagious diseases,
- the process of self-heating is hindered and there will be no fires at the waste dump, which are otherwise common in the summertime and in regions with warmer climate,

- unpleasant smells from decomposition of the organic matter are eliminated, and
- measures are taken for protection of the soil, groundwater and air, thus minimizing the pollution in accordance with the characteristics of the working environment.

The mining company can obtain the additional income from the waste-dumping part of operation, by charging for the excavated and now available space, additional works and overburden material for the cover. The waste-disposal company and the mine can find the common interest for this work, while the mine is additionally encouraged to be strict in completion of the planned operations thoroughly and in time, because it would otherwise have to deal with a large and open waste dump in its own backyard. In any case, a very important part of this concept is that the price of the waste dumping works within a mining operation can be significantly lower than in the case of an isolated, self-existing waste dump.

#### **TEST MODEL (THE ILOK CLAY PIT, CROATIA)**

Based on the mentioned rationalisation, a specific technical solution is proposed for an open clay pit (Fig. 2). The clay is excavated at benches and transported by trucks through the open pit, while the waste is transported by a public road and by the additional road directed to the uppermost bench from which the waste is directly dumped in the excavated spaces. This way, the external and internal (mining) transport are completely separated, and waste trucks will remain free from excessive mud or dust, which is important because they will be returning to the city to pick up more waste. The bulldozer is used to push the dumped waste along the main plateau and to cover the waste with clay material, which is considered to be overburden. The construction of 120x60x15m cassettes is planned [2], each capable of receiving approx. 50,000 m<sup>3</sup> of waste and 25,000 m<sup>3</sup> of overburden. The consolidation coefficient for the waste is  $k_c=1.4$  and for the overburden (clay) it is  $k_c=1.1$ , which means that each cassette would suffice for the period of three years because the production of the communal waste in the city of Ilok is calculated to be around 20,000

m<sup>3</sup>/yr. As a standard measure for the sanitary waste dump, the collector for the rainfall and groundwater coming through the waste is planned where waters could be purified and subsequently discharged into environment. As illustrated in Fig. 2, with continuation of the mining operation the new cassettes are formed and successively connected to the drainage system and water purification facility.

## CONCLUSION

Waste dumping in the scope of an ongoing mining operation is a new idea and a new concept, wherein the excavation of the mineral raw material and dumping of the overburden (mining waste) take the waste dumping as an integral part of the future mining works. The method is logical and simple, for the classical mining operations are almost the same as the waste dumping activities and they are performed in the same area, with the same machinery, crew and supervision, and they also can last for the same period.

Removing of the overburden and excavation of the mineral raw material results in an alteration of the natural environment which is not so irreducible should the additional waste masses be brought into the emptied space. This could facilitate the restoration of the initial shape or some other purposeful reshaping.

The form of cassette dumping is considered adequate because the cassettes can be formed

as a side-job by the internal dumping of the overburden soil masses. The size of cassettes can be adjusted to the conditions at the open pit, intensity of excavation of the mineral raw material and to the quantity of waste that is planned to be dumped. Additional insulation of the waste masses is planned due to characteristics of the surrounding sediments and because of the specific location in the food-producing eastern part of Croatia.

The method is technologically feasible, ecologically reliable and economically incentive, which makes its application unquestionable. This is especially so in the case of smaller pits that can be found at many locations not very far from the settlements, because of the significant reduction of the transport costs. The test model is in the final phase of realization and its effects are going to be studied in the future contributions.

## REFERENCES

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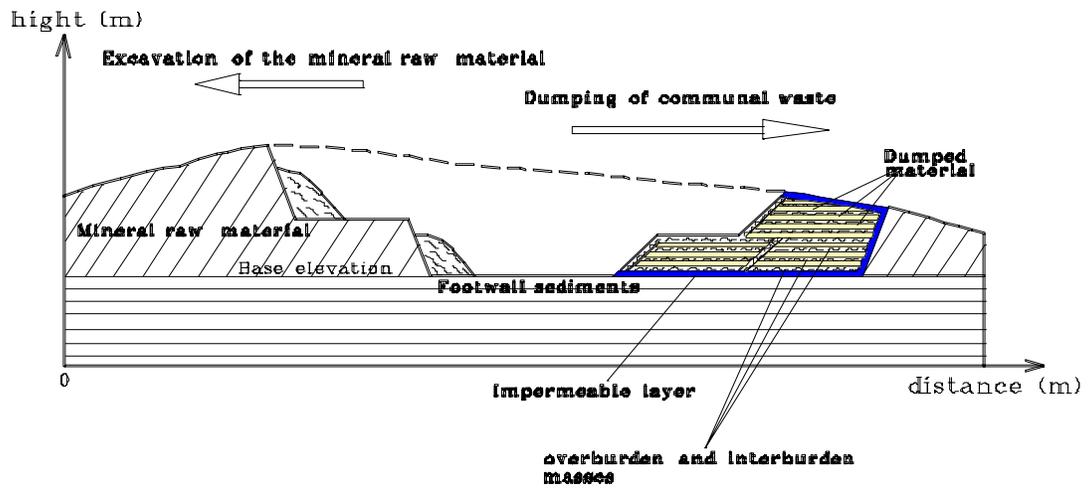


Fig. 1. Basic concept of the waste dumping within the mining operation.

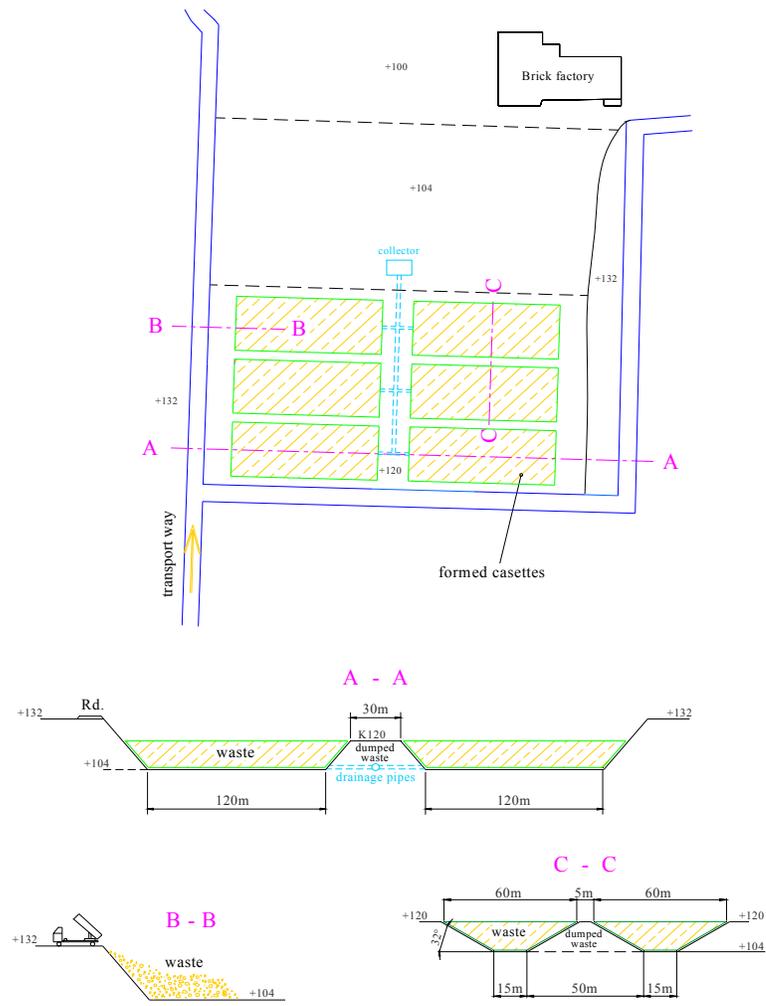


Fig. 2. The system of the cassette waste dumping at the Ilok clay pit.