

## RECYCLING AND WASTE-FREE TECHNOLOGIES IN METALLURGY

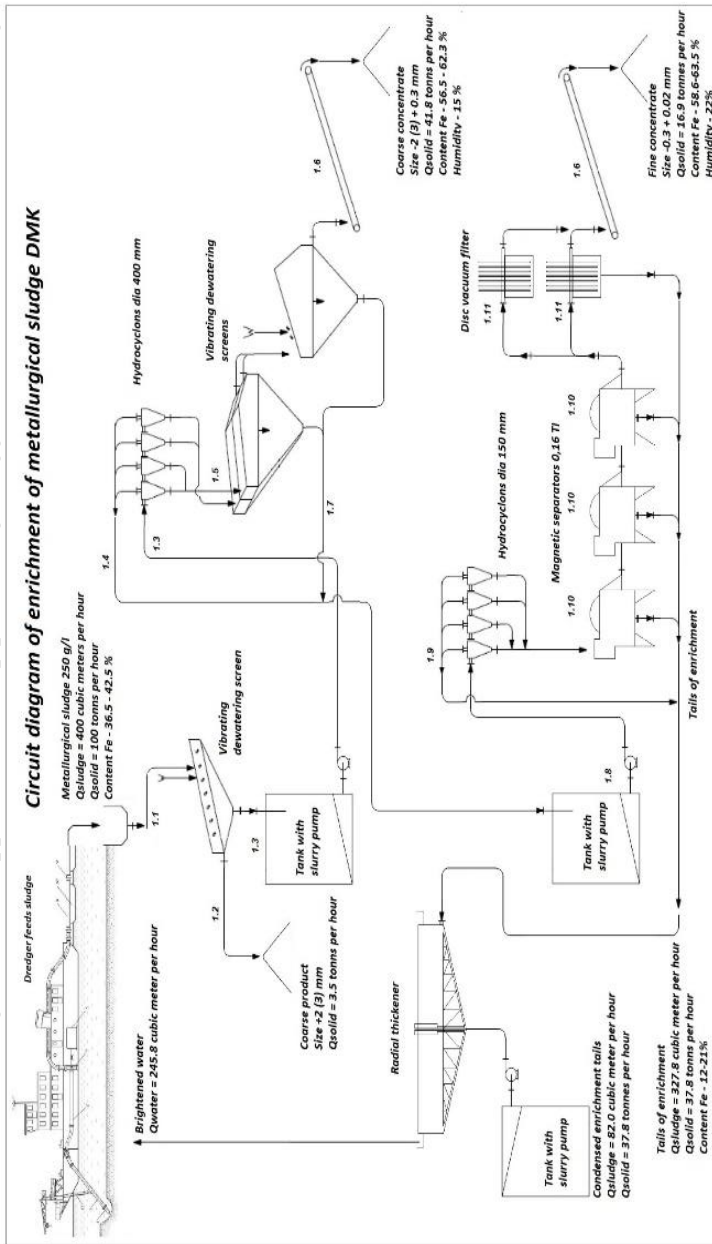
**Oleksandr Dreshpak**, Assoc. Prof. PhD-Tech.  
*Dnipro University of Technology, Ukraine*

**Introduction.** The article presents review and an analysis of slags and sludge in the Ukrainian metallurgy. The volume of production and the degree of slag processing is lower compared to the European indicators. The volume of production and the degree of sludge processing is considerably lower than the European indicators. The main processing technologies and their disadvantages are considered. New technological schemes for deep concentration of sludge are proposed.

Waste-free technology of ferrous metal ores processing is a modern concept of sustainable development in ferrous metallurgy, which starts from exploration of deposits to industrial or domestic use of finished products. On the other hand, the finished products or waste become a source of raw materials for another redistribution, where they will produce the same or more frequently different type of marketable products.

**Presentation of the main research.** Metallurgical enterprises of Ukraine produce slags in large quantities. Pyrometallurgical processes are huge sources of waste if not recycled and disposed of properly. With a rapid increase of resource consumption, free land for filling a large amount of metallurgical slag is decreasing throughout the world, and as a result the cost of disposal is becoming higher. The impact of global warming and natural resource conservation are common environmental problems in the world (Shaposhnykova, 2019). Moreover, slag warehouses result in air, water and soil pollution, as well as negatively affect the health and growth of plants and vegetation, etc. We looked at the slag and sludge research trend and found that there is a significant increase in slag processing. The ideal goal is to develop a sustainable systemic cycle that can transform all the valuable resources that are taken out as waste into useful products and achieve absolute recycling (Slag Processing, 2021).

**Figure 1**  
 Circuit diagram of the apparatus for deep processing of agglomeration and blast furnace sludge



The metallurgical industry directs its efforts to minimize and recycle slags to meet the environmental objectives. Various metallurgical slags are formed during the mining, refining and steel alloying processes (Kovalenko et al., 2008). Due to the large amount of slag and stricter environmental regulations, the processing and disposal of these slags are an attractive alternative to reduce and ultimately eliminate disposal costs, minimize environmental pollution, and save resources preservation.

**Conclusion.** There are a lot of technologies used for processing slag and sludge from the metallurgical industry, and no one can provide with the deep processing of dust from the agglomeration and blast-furnace departments.

A general gravitational-magnetic circuit diagram of the apparatus for processing sinter, blast-furnace and steel-smelting sludge is proposed. It will allow additional extraction of iron with a content of  $\beta = 56-62\%$  and a finished product yield of  $\gamma = 25-45\%$ , depending on the mining zone. Processing tailings are a mixture of quartz and limestone grains with a content of  $\nu = 6-18\%$ , which can be used as a mineral filler. Thus, it is possible to deeply process wastes from blast-furnace, sintering and steel-making industries, followed by additional extraction of conditioned iron concentrate, suitable for charging blast furnaces, and obtaining mineral raw materials for construction.

### References

Kovalenko, I. M., Kovzun, I. G., Ulberg, Z. R., Procenko, I. T., & Vashenko, A. A. (2008). Nanostructural formations in enrichment processes iron oxide-carbonate-silicate metallurgical sludge. *Nanosystems, Nanomaterials, Nanotechnologies*, 6 (2), 443-478.

Shaposhnykova, O. (2019). Income from waste: Ukraine can double slag processing and exports. <https://gmk.center/posts/dohod-iz-othodov-ukraina-mozhet-udvoit-pererabotku-i-eksport-shlakov//>

Slag Processing (2021). Slag Processing – Metallurgical Slag Processing Complexes. <https://www.amcom-usa.com/ru/solutions#solution1>