



## **SPECIFIC FEATURES OF SAND EXPLOITATION TECHNOLOGY IN DEPOSIT JAKOVAČKA KUMŠA WITH HIGH GROUNDWATER**

Branka JOVANOVIĆ<sup>1</sup>, Željko PRAŠTALO<sup>1</sup>, Dragan MILOŠEVIĆ<sup>1</sup>, Simeun MARIJANAC<sup>1</sup>

<sup>1</sup>Mining institute, Belgrade, Serbia, povrainska@ribeograd.ac.rs

### **ABSTRACT**

Topic of this article is technological solution of construction sand exploitation in existing excavation zone and in extension of the exploitation field in sand deposit Jakovačka kumša in coastal environment of river Sava, aquifers in sediments supplied from the river and the system of melioration channels which maintain the level of ground water.

Key words: sand, exploitation, hydraulic and float dredger

### **1. INTRODUCTION**

Territory of the sand deposit Jakovačka kumša belongs to local municipality Surčin in Belgrade, 30 km far away from the city centre.

In morphological sense the narrow area of the sand deposit represents the alluvial plane of the river Sava with altitudes of +72- +77 m, in average +74 m. Building of defensive embankment of river Sava and network of the melioration channels it was prevented flood from the river bed of Sava and ground water level was regulated maintained at the level of +71 m.

Geological material on the narrow territory of deposit is represented with Quaternary sediments: clay, yellow fine-grained sands, gray sands, gravelly and sandy clays.

Productive series of Jakovačka kumša deposit is made of yellow fine-grains and gray sands. The top layers of the productive series are made of sandy clays and humus and in the bottom is sandy-gravelly series.

Based on geological material typology of some sediment porosity and hydrodynamic conditions in the frame of Jakovačka kumša deposit, it is possible to select 3 types of aquifers:

- 1) Compacted type of higher abundance within (bottom) sandy-gravelly sediments with altitudes of +58.55 - +37.24 m.
- 2) Compacted type of lower abundance within gray sands (lower layer of productive series) which are above sandy-gravelly sediments with altitudes of +62.70 - +54.74 m.

- 3) Conditionally anhydrous sections of terrain connected with yellow fine-grained sands (upper layer of productive series) with altitudes +68.22 - + 57.30 m and the overburden of productive series, clayey sandy humus.

Supply of aquifers of type 1) and 2) is provided from the river Sava, from old fossil bed and by infiltration of rainfalls and drainage during low water level toward the river and artificially via tubular and artesian wells.

In the former period of 5 years in the area of Jakovačka kumša deposit, the public company (JP) Surčin exploited sand by discontinued system, hydraulic dredge-trucks. Excavation of sand at deeper levels (up to 66 m) resulted in excavated zones backfilled by water. On such these surfaces, in extension of the sand exploitation, will be exclusively executed underwater exploitation by the system float dredger - pipeline - precipitators.

JP Surčin is presently in the procedure of widening the exploitation field the purpose of which the Mining Institute doo Beograd made the Main mining project on construction sand exploitation in Jakovačka kumša deposit.

The project defines two periods of exploitation:

- 1) Up to 10<sup>th</sup> year of exploitation with system of underwater exploitation implementation, and
- 2) From 11<sup>th</sup> until the end of exploitation (48<sup>th</sup> year) with combination of classical discontinued system and underwater exploitation system.

## **2. PRESENT SITUATION OF WORKS ON SAND EXPLOITATION AND CONTINUATION OF EXPLOITATION UP TO 10<sup>TH</sup> YEAR**

The figure 1 illustrates a satellite record where is visible present situation on the surface mine Jakovačka kumša. The sand is excavated by the floated dredger- suction (1), hydraulically transported together with water by float and ground pipeline (2), toward prepared cassettes or precipitators, (3) and (4).

The same figure illustrates water surface (5) formed in the zone of exploitation in the frame of approved exploitation field. On the eastern side, in the frame of approved exploitation field is so called inner landfill (6), actually utility landfill which has narrowed exploitation area. Also on the eastern side of the exploitation zone, is municipal asphalt road (7) that goes to Jakovo on the north side of the surface mine, toward river Sava embankment on the south side of the surface mine.



Figure 1: Present condition of work on the surface mine Jakovačka kumša

Due to already excavated top layers, excavated zones backfilled with water and lack of the condition for excavation by hydraulic dredgers, continuation of excavations up to 10<sup>th</sup> year of exploitation will be performed by underwater procedures.

The sand, excavated and sucked in by float suction dredger will be transported together with water by dredger's float and ground pipelines with diameter of ( $\emptyset$ ) 300 mm to precipitators (figures 1 and 2). Maximum length of the float pipeline in next 10 years will be of 400 m. hydraulic transported sand, together with water, will be placed in precipitators to sieve and dry, and then it will be loaded in trucks by hydraulic dredger, directly or indirectly. The figure 1 illustrates 2 precipitators which are filled and emptied in alternating mode, (3) and (4).



Figure 2: Underwater exploitation system on the surface mine Jakovačka kumša, float suction dredger – pipeline – precipitator

Excavations of sand will be performed in the existing exploitation zones up to designed excavation plane with altitudes +60 - + 63 m, and on depth of 8-11 m in relation of the water level, by work of the floatsuction dredger in 3 sub-floors with altitudes +66, +63 and +60 m.

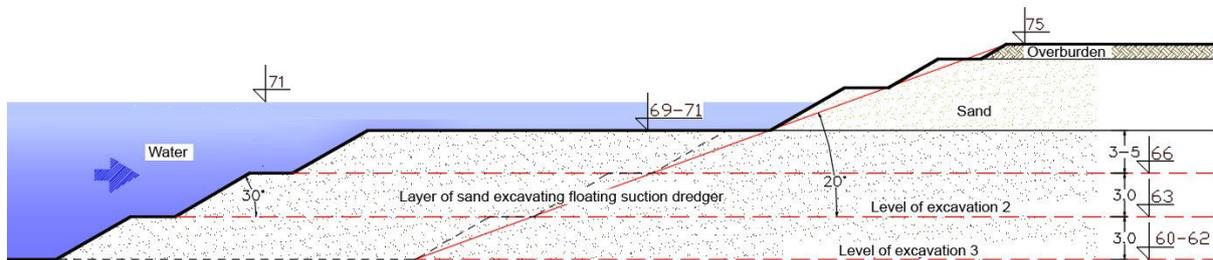
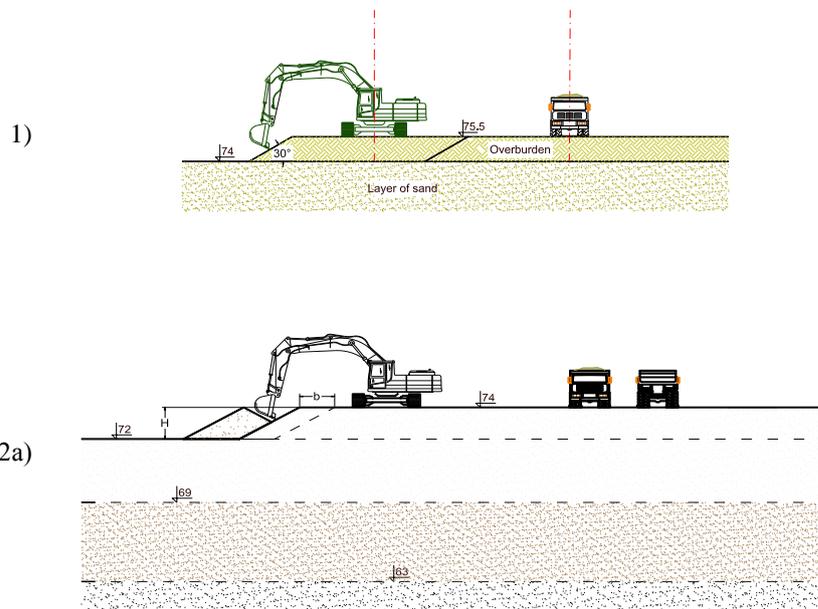


Figure 3: Technological profile of surface mine Jakovačka kumša, I phase to 10<sup>th</sup> year of exploitation

### 3. SAND EXPLOITATION AND OVERBURDEN IN EXTENDED SECTION OF THE SURFACE MINE AND EXPLITATION FIELD

Exploitation of construction sand and overburden on the Jakovačka kumša deposit, in the extension of surface mine, from slopes of present excavation zones (Kumša 1 and Kumša 2) to final slopes in the contour of new extended exploitation field designed as combination of discontinued surface exploitation and continued underwater exploitation.

Sediments of Jakovačka kumša deposit inside of designed surface mine will be excavated in 3 floors.



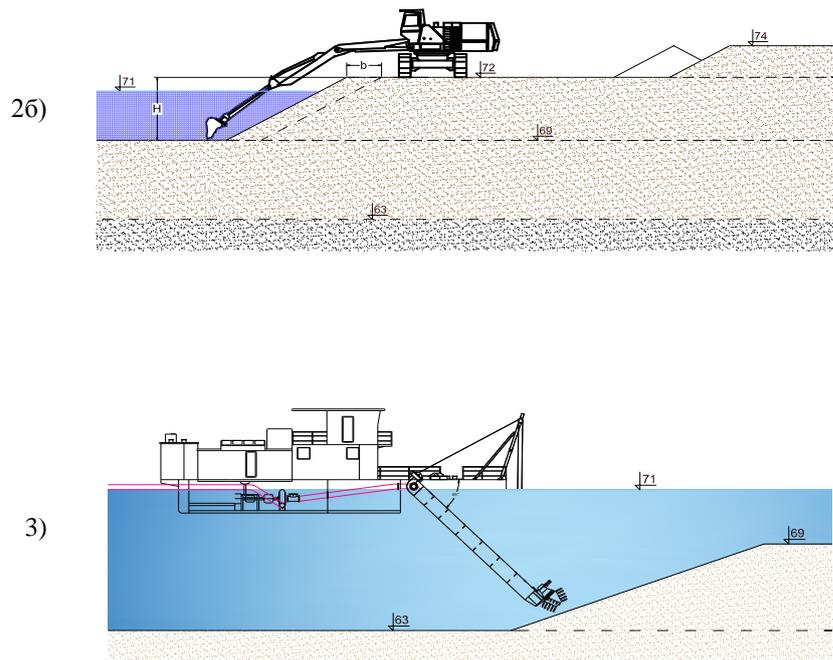


Figure 4: Excavations in contour surface mine Jakovačka kumša

On the floor 1 will be excavated materials from overburden, humus and clayey 0-3.1 m, by hydraulic dredger with direct loading in trucks.

On the floor 2 will be excavated sand in 2 sub-floors with two different hydraulic dredgers:

- Upper sub-floor (2a) excavates hydraulic dredger which excavates overburden; the dredger is placed on the surface of the layer-sand, it excavates 1<sup>st</sup> sub-floor to altitude +72 m, and at the same time takes the sand placed by the dredger work on the lower sub-floor and loads it directly to trucks;
- Lower sub-floor (2b) excavates hydraulic dredger with longer mast which is placed on altitude +72 m, excavates sand partially below the water level to altitude +69 m and temporarily place it on the standing level with working slope of higher sub-floor and in zone of 1<sup>st</sup> dredger.

On the 3<sup>rd</sup> floor sand will be excavated by float suction dredger from altitude +69 m to +63 m in two sub-floors of 3 m high and transported through pipeline to precipitators.

Sand excavated in 3<sup>rd</sup> floor by float sucking in dredger (Figure 4-3) will be transported together with water by the pipeline with diameter of 300 mm to precipitators where it will be drained and then loaded in trucks and transported to consumers.

For continual underwater exploitation it is necessary to predict, in each period of exploitation, two precipitators (or cassettes) for sucked and hidraulic transported sand. Simultaneously, in one cassette will be performed hidraulic filling and in other loading of dried sand in trucks.

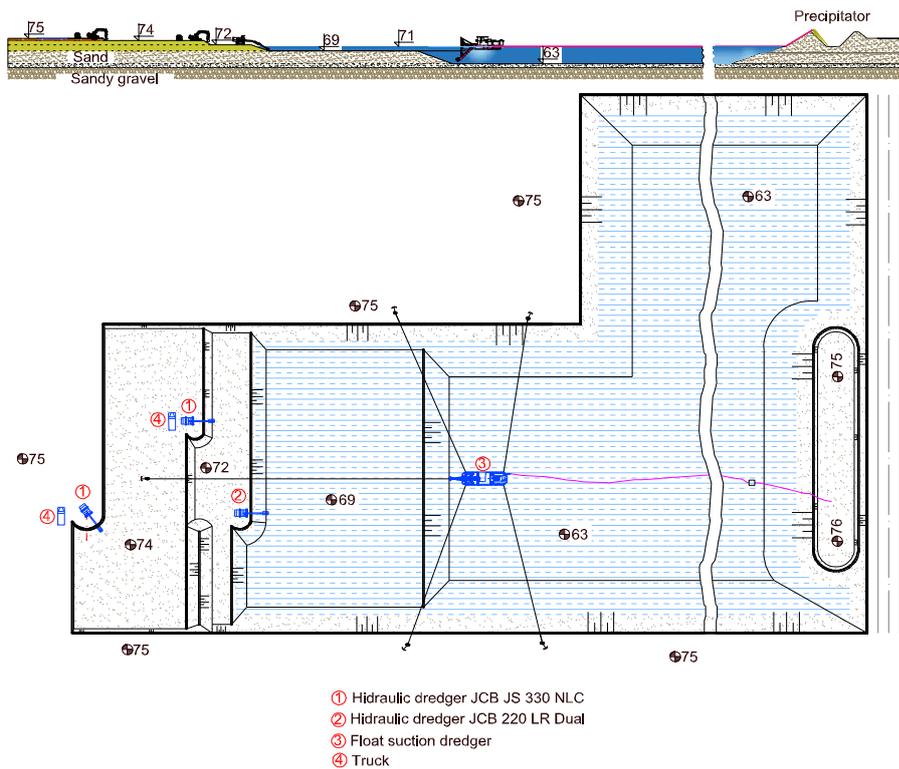


Figure 5: Consistent technological scheme of sand excavations and overburden in extension of surface mine Jakovačka kumša.

Figure 5 illustrates consistent technological scheme of excavations of overburden and construction sand on surface mine Jakovačka kumša, in plan and cross-section, in full development of the surface mine, in the period from 11<sup>th</sup> to final 48<sup>th</sup> year of exploitation.

## REFERENCES

- [1] The main mining project of construction sand exploitation on the surface mine Jakovačka kumša, Mining Institute Belgrade, 2017.
- [2] Evaluation and impact study of designed surface mine Jakovačka kumša – Jakovo by underwater exploitation, on part of Belgrade source and designed source Zidine, RGF & Ekoton, 2017.