Systems of raising deep-water concretions

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Summary. The systems of raising of hard minerals are considered from the sea-bottom, taking into account characteristics of the deposit, condition of the environment, technological and technical parameters of extracting of concretions. The given classification of the pipeline, wire-rope-bailer, off-line and combined systems of raising on the type of stream, mobility of the system of raising of concretions, amount of parallel streams of mountain mass and structural break of technological chain.

Key words: hard minerals, systems of raising, deep-water concretions, mountain mass.

INTRODUCTION

Research, survey and survey work carried out over the past decade in the ocean, allowed to establish the prospects shelf zone and open ocean areas to detect deposits of solid minerals (SSM): Ore liquid dispersed noble metals and building materials. Specific role of water that covers the field and is a source of many valuable chemical elements, called liquid ore.

The peculiarity of the conditions of occurrence of TCC deposits characterized by type of minerals and ore bodies, genesis, deep water layer, and the distance from the shore or industrial developed areas. Under these conditions, the system is particularly important lifting the rock mass composed of floating exploration or exploitation ocean technological complex. The type of lifting determines the choice of design and procedures for the use of other systems, subsystems and complex as a whole.

The system of recovery of solid minerals depends strongly on the depth of water, is associated with lifting height range transport and vertical rock mass, and is the primary choice in the type and capacity of the drive weight and size and design of load funds, and hence displacement craft [1].

It is advisable to subdivide lifting systems according to specific areas of the hypsometric curve, reflecting the geomorphological features of the structure of the ocean floor: shallow and coastal zone (depth 50 m); small depths and shelf (200...600 m); average depth, continental slopes (2000 m); greater depths and areas of mid-ocean ridges (4000 m); and lodges deep ocean (4000...6000 m).

The choice of lifting is also determined by the type and properties of underwater mineral deposits corresponding to the characteristic depth of the occurrence. The deposits are divided into: sand and gravel alluvial marine shelf areas in the seas and oceans (depth 200...600 m); metalliferous muds and brines bottom depressions (up to 2000...2500 m); cortical ore guyot (3000 m); sulphide ore mid-ocean ridges (4000 m); deep-sea nodules (4000...6000 m).

PURPOSE OF WORK

Purpose of work – systematization schemes of lifting nodules during their extraction. The most difficult to select and justify is the is lifting system for nodules that occur under conditions of high pressure and aggressive environment countervailing currents, low temperature, low water clarity with a typical multilayer deposition of ore fines particle size of several centimeters [2]. The basis of the scheme of systematization lifting nodules (SEC) is their technological properties.

SYSTEMS OF LIFTING NODULES

The main technological properties of IBS include: type of rock mass flux, spatial mobility of lifting, the number of streams and constructive dissolubility technology chain apparatus. The combination of these properties quantitatively characterizes the opportunity to achieve specified performance, depth, height, raising the level of energy and capital costs, loss of minerals, the stability of the process in operation, production flexibility and agility of recovery.

1. *By the type of flow;* diagrams of lifting nodules are divided into systems with continuous and discrete flow of the rock mass, which lift (Fig. 1).

Continuous – flow pipeline IBS type (pump, airlift, ejector, the empty recesses element double piped with floating stream of stimuli of different modifications) have fundamental limitations in performance with a range of values – 4...5 million tons per year for one set. Such performance can be achieved by increasing the quantitative characteristics of the system: the diameter of the pipe, flow rates, pump power or the performance of compressors etc. The limit specifies the technical characteristics of lifting units and other systems and subsystems, such as the fact that it is impossible to achieve the specified performance collection nodules. In this design, the number of units and the order of interaction of raising remain the same for any given performance.

The structural type and main technical and economic indicators of IBS various designs with discrete flow rock mass is stored in the specified range for which the system can be divided into small portions (with unit weight lifted load, up to 1 ton), tonnage (1…100 ton) medium-duty (100...1000 ton) and large- (> 1000 ton). These ranges roughly determine the limits of rational use of discrete flow and characteristic structural features. For example, for the extractive complexes of autonomous type (with submarine pop-up vehicles) a transition from low-tonnage to the middle-tonnage systems of getting up is possible at creation fundamentally of more mighty energy sources, and to large-tonnage – after the radical improvement of the systems of buoyancy.

Concept of continuity and discreteness in combined lifting systems applied separately to each of the processing chain formed by aggregates of one structural type.

2. *The mobility of lifting nodules* – the most important technological feature that depends on the combination of the properties of other elements ocean technological complex and the adopted excavation of nodules. The distinctive feature – the speed of the lifting system as a whole with respect to the bottom during removal. Increase speed is undesirable as rising energy costs, the complexity of managing transient conditions, the mechanical load on the structure of aggregates that are operative strength close to the boundary. In addition, the increased speed of movement ocean technological complex usually difficult navigation safety and increases loss of extraction.

The degree of mobility of lifting nodules can be divided into still in the process of removing, slow-moving (up to 0,3 m/s) and fast moving (0,3...3 m/s). Quantification of mobility limits driven by strong growth in its hydrodynamic resistance.

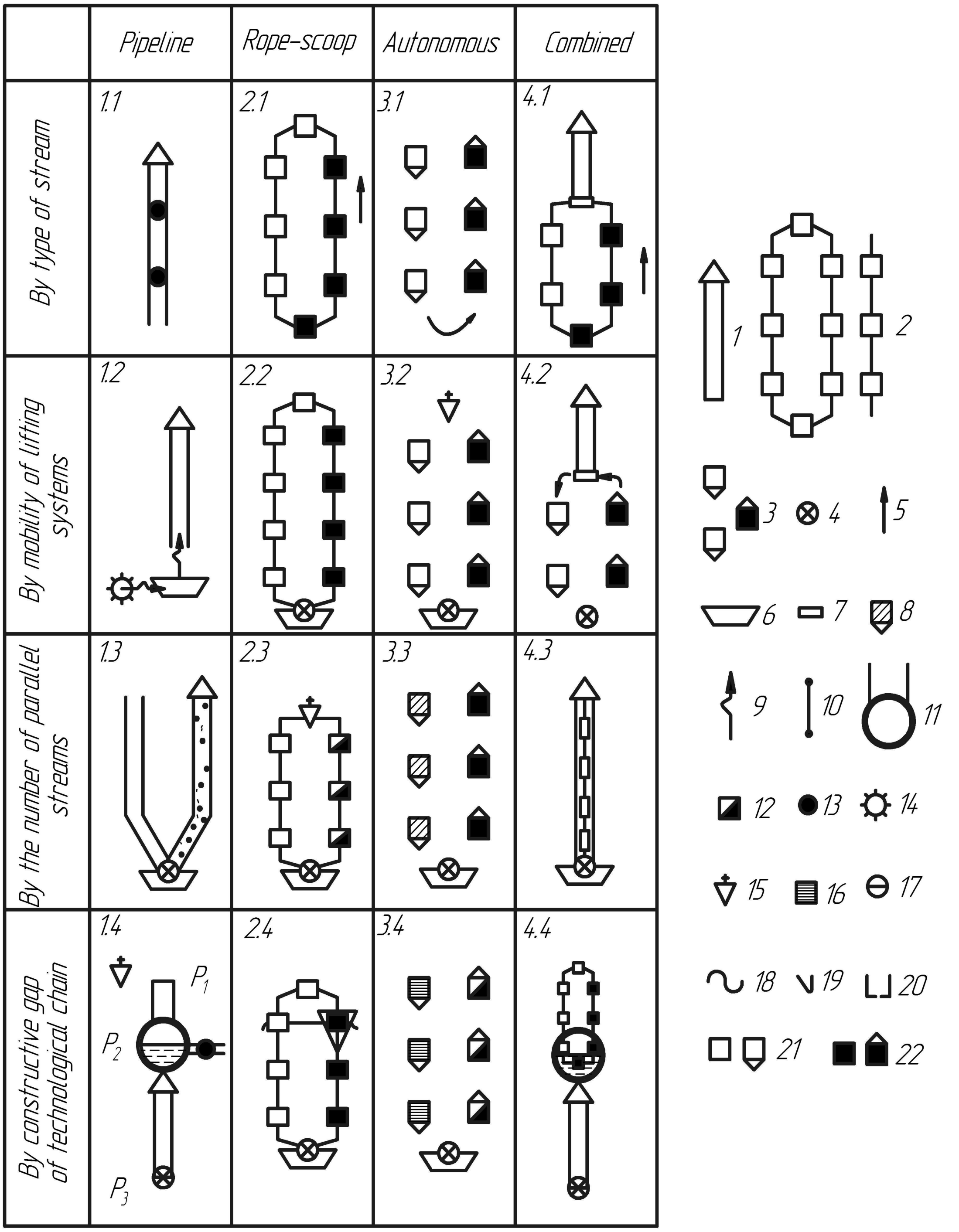

Fig. 1. Lifting schemes of solid minerals:
1 – pipe, *2* – rope, *3* – autonomous, *4* – unit fee, *5* – direction of the flow of the rock mass, *6* – chassis, *7* – intermediate tank, *8* – the capacity of the ballast, *9* – flexible pipe, *10* – rope, *11* – buried an empty element, *12* – with gas-filled container and cargo compartment, *13* – drum pump, *14* – up, *15* – craft, *16* – chemical element of the filler, *17* – the capacity of the pulp, *18* – wave energy, *1*9 – bunker, *20* – Mechanical grippers, *21–22* – capacity, *21* – loaded, *22* – blank

The mobility of lifting in aggregate form reflects the level of energy, loss of minerals, reliability and stability of exploration and development activities. All these parameters vary in inverse proportion to the speed of movement of frontal lifting and ultimately meets the changing aggregate costs of removal, that the criterion of choosing the optimal technological IBS. Therefore, analysis of mobility can be used for rapid qualitative

assessment, comparison and selection lines of development schemes and facilities ocean technological complex.

3. *Number of parallel streams of rock mass* in the technological scheme reflects its compliance with safety requirements, production flexibility, mobility , stability during temporary worsening conditions and suitability of the system to build (if necessary) performance. Obviously, the lifting system with several structurally decorated rock mass flows will satisfy these requirements in the best way, but have a high cost and other disadvantages. A part form single-threaded and multi-threaded streaming potential site flow diagrams, Multithreaded efficiently perform only in areas with the most difficult conditions with reduced performance or reliability units.

4. *Constructive dissolubility processing chain aggregates* characterizing compliance of the scheme marine operating conditions. An important feature here is the presence of continuous mechanical coupling between aggregates processing chain, which has a negative impact on operating system reliability and stability of the process and makes it difficult to ensure the safety of the system. Quantitatively, the joint effect of threading and constructive gaps expressed value of the coefficient of efficiency of working time ocean technological complex.

Lifting schemes of nodules can be divided into inseparable with permanent mechanical connection between the aggregates extraction and craft, and discontinuous, having no such connection in all or part of depth recovery. Discontinuous system in the first case related to autonomous, the second – to the combination as lifting devices connect different structural types. Systems of lifting unbroken chain units can also be combined if units include lifting of different structural types.

Dissolubility processing chain increases its flexibility and production flexibility, but in the cases involving temporary connection of underwater units (i.e., their docking), significantly complicates the design and operation of such systems and reduces the stability of the process.

DISCUSSION AND REFERENCES

As part of the ocean technological complex lifting scheme can be used as nodules with ground gear (or machine) – unit cleaning (Chart 1.2 – 4.2 on Fig.1) and without (Chart 1.1 – 4.1 on Fig.1).

Economic indicators rise SEC using different agents of flow in piping systems or devices of discrete flow systems, such as light liquids, gases, light elements, ballast material (Chart Fig. 1.3 – 4.3 on Fig.1).

Techno-economic performance of different technologies of lifting nodules can be significantly enhanced by the energy of the sea (classified important features), such as: pressure drop across the system with empty recesses element of wave energy in the chair of container lifting systems, the potential energy of inert materials being substituted for utility deposits in the aggregate collection of discrete flow systems, lifting (Chart Fig. 1.4 – 4.4 on Fig.1).

Structural classification features of deep nodules lifting scheme is closely related to technological parameters, causing the appearance of lifting and ocean technological complex as a whole and, to a large extent, the number and characteristics of major units and technical-economic indicators of the complex.

CONCLUSIONS

1. Promising useful raw material for extraction of manganese, nickel, copper, cobalt and others. Polymetal is concretion ores occur in the central regions of the ocean floor. The terms of their occurrence at a depth of 4000...6000 m are complex and unique. Therefore, the most important this is the raising of nodules floating in intelligence or operational enterprise.

2. Lifting systems are divided into pipeline, chair scoop, standalone and combined with the unit picking up without it. Their effectiveness is enhanced by the use of different pathogens flow and seas.

3. Signs of systematization schemes lifting nodules are: continuity (in hydraulic) and discrete (in the rope-scoop and autonomous) flow of raw material; degree of mobility of the complex system recovery and the number of concurrent streams and constructive dissolubility technology chain apparatus.

REFERENCES

1. **Bakurov G., 1988.** Ships for deep-water mountain geological researches. Moscow, Shipbuilding, № 3, 12-16.
2. **Ferromanganese** concretions of the central part of the Pacific ocean, **1986.** Under editing I.O. Murdmaa, N.C. Skorniakova. Moscow, Nauka, 344.
3. **Fouco I., 1982.** Modern state of technique of booty of deep-water ferrimanganese concretions. VTZP, Nr E-41418, Moscow, 28.12.83, ist. Fusen, Vol.29, 99-167.
4. **Nurok G., Brujakin Yu., Bubis Yu. and other., 1979**. Mining technology from the bottom of lakes, seas and oceans. Moscow, Nedra, 381.
5. **Ogorodnikov С.П., 1986.** Hydromechanization of development of soils. Moscow, Stroyizdat, 256.
6. **Paschkin V., Iakovlev P., Cokolov V., 1999**. Dredging, turning and gidromechanized works: train aid. Odessa, Astroprint, 432.
7. **Schniukov E., Ziborov A., 2004.** Mineral riches of the Black sea. Kyiv, NANU, 279.
8. **Shkaryvsky G., 2014.** Estimation of influence structurally of layout charts of power facilities on completing of aggregates on their base. Motrol: kom. Mot. Energ. Roln., OL PAN, Vol.16, No 3, 165-171.
9. **Sukach M., 2004**. Booty and portage of ocean metal of containing crusts. Industrial hydraulic and pneumatic, Vol.3(9), 8-11.
10. **Sukach M., 2004.** Workflows of deep machines. Kyiv, Naukova dumka, 364.
11. **Sukach M., 2012**. Deep-water technique and technology for development of minerals of the World ocean. Labours VI ISTK "Energia-2012", Simferopol-Alupka, 9.
12. **Sukach M., 2012**. Problems of booty of hard minerals from the bottom of the World ocean. Motrol: kom. Mot. Energ. Roln., OL PAN, Vol.14 (1), 116-122.
13. **Sukach M., 2013.** Prospects of разработки of marine deposits of mineral raw material. Innovations in science are innovations in education: collection of labours. JuRGPU (NPI), Novocherkassk, 285-291.
14. **Sukach M., 2013.** Research and development deep-water booty technique. Gìrničì, budìvelnì, dorožnì ta melìorativnì mašini [Mining, constructional, road and melioration machines], Vol.82, 57-65.
15. **Sukach M., Lysak S., Sosnowski S., 2010**. Kinematic analysis of trencher's working process. TEKA: kom. Mot. Energ. Roln., OL PAN, Vol. X, 425-431.
16. **Sukach M., Lytvynenko I., Bondar D., 2009**. System of the automated management and measuring of parameters of technological processes. Motrol: kom. Mot. Energ. Roln., OL PAN, Vol.11B, 186-189.
17. **Technical** instructions on the production of the marine dredging, **1986**. РД 31.74.08-85. Moscow, W/S Mortechinform reklama, 172.
18. **Ziborov A., 2006.** To obtain or not obtain the black Sea sapropels in Ukraine. Geology and minerals of the World ocean, Vol.1, 92-99.
19. **Ziborov A., 2008**. Prospects and tasks of mastering of marine deposits of mineral raw material. Geology and minerals of the World ocean, Vol.3, 5-18.

СИСТЕМЫ ПОДЪЕМА ГЛУБОКОВОДНЫХ КОНКРЕЦИЙ

Аннотация. Рассмотрены системы подъема твердых полезных ископаемых из морского дна, с учетом характеристик месторождения, условий окружающей среды, технологических и технических параметров добычи конкреций. Дана классификация трубопроводных, канатно-черпаковых, автономных и комбинированных систем подъема по виду потока, подвижности системы подъема конкреций, количеству параллельных потоков горной массы и конструктивной разрывности технологической цепи.

Ключевые слова: твердые полезные ископаемые, системы подъема, глубоководные конкреции, горная масса.