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# Cleaning of Underwater Objects Technology

By Doktor Rodionov Viktor

*Introduction-* The uniquely designed and patented *Cavimax Technology And Equipment* is developed to clean underwater surfaces:

- Sea-craft, ships and freshwater vessels of different g1ass (tankers, dry cargo ships, yachts, cutters) ;
- Stationary hydro-technical structures (piers, moles, moorages);
- Sea platforms for various purposes (oil, gas extraction);
- Pipelines and other stationary submarine objects.

Underwater cleaning *CAVIMAX TECHNOLOGY* is based on the cavitation effect and is used for qualitative and high-speed destruction and removing of marine growth of any thickness (seaweed, shells, corals)', rust and peeling paint without damaging the hull and a protective coating. The surface can be cleaned Passive voice to bare metal with the help of the operating mode selection of the cavitating stream.

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## I. Introducation

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The *CAVIMAX EQUIPMENT* uses outboard sea or river water creating a speed cavitation max with microscopic Unusual word pair steam Possibly confused word of bubbles under 150- 250 Bar with a capacity of 200 l/min (standard pumping plants). Upon contact with the surface being cleaned Passive voice, these bubbles implode. The result of the microscopic bubbles imploding is the destruction of marine growth, rust and, its removal from the work area. During this process, the working pressure reaches up to 10,000 Bar at the cleaned area.

The newest *CAVIMAX*-technology uses the *SPECIAL CAVIMAX CLEANING SYSTEMS:*

- Hand-held diving climax pistols for cleaning curved and hard-to-get surfaces with a cleaning rate up to 250-350 $m^2$/hour (equipped with or the jet nozzle for compensating recoil and power level control);
- Semi-automatic self-propelled climax heads of various types for cleaning flat surfaces for different thicknesses of marine growth and a cleaning rate up to 1200- 1500 $m^2$/hour (equipped with adjustable climax automatic propulsion, or the hydrodynamic suction system to clean objects and remove waste from the work area, speed adjustment, and power level control);
- Remote-controlled programmable climax cleaning devices with improved productivity (pilot designs);
- Unique Repetitive word: devices for post-cleaning polishing of the underwater hull (for curved and flat surfaces);
- Underwater telemetry and video control of the process;
- Remote above-water control of operating devices is available.

The complete equipment package - self-sufficient, modular, mobile - is formed depending on production requirements and user's needs.

*EFFECTIVENESS AND INNOVATION* of underwater hull cleaning climax equipment:

- Highly efficient and qualitative cleaning (up to 2500 $m^2$/hour) of vessels without docking;
- Rapid cleaning (up to 1000 $m^2$/hour) of curved and hard-to-get surfaces (propellers, rudders, Kingston, supports of hydro-technical structures, pipelines);
- Safety for divers;
- No damage to paint and varnish coatings of surfaces cleaned;
- No need for periodic replacement of tools and consumables during operation;
- Uninterrupted round-the-clock running;
- Cleans any surfaces (metal, aluminum, plastic, wood, concrete, etc.);
- High maintainability and reliability during the long-term;
- Choice of level, speed and cleaning modes (the hull can Repetitive word: cleaned Passive voice to bare metal) ;
- Application of standard above-water pumping utilities (150-200 l/min, 150-250 bar);
- Remote above-water control (including programmable control).

The newest *UNDERWATER CLEANING CAVIMAX TECHNOLOGY AND EQUIPMENT* drastically enhances labor productivity and quality. Cavimax technology makes cleaning services highly cost-effective in today's market.

1. Of the underwater accretion elimination technologies using the mechanic brushes (like “Sea Brush”) and the Possibly miswritten world instrument series CAVIMAX.

The proposed newest Possibly miswritten world technology developed and patented Viktor Rodionov (Russia) [ 3,4] exceeds the currently used technology, based on the implementation of hydraulic disc mechanical brushes, in many characteristics. Depending on the required productivity, devices with one, two, and three- disc brushes may be used Passive

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voice. Out of the production of the PHOSMARINE company, being most wide-spread in the sphere of underwater cleansing, the Overused word "Sea Brush" mechanism with one disc brush weighs about 30 kg and has the productivity of 200-300$m^2$/h while the Overused word mechanism with three-disc brushes "Brush Cart" weighs 170 kg and has the productivity of 1800 $m^2$/h.

The Possibly miswritten word instrument of likewise productivity weighs 3 kg, correspondingly, whereas "Sea Brush" weighs 30 kg.

Divers, who cleanse the surfaces of the ships from accretion underwater, perform hard physical work, which requires oxygen consumption of 2. 5 – 3. 0 liters/minute, the heart rate is 140-160 b/m. Such activities may be performed Passive voice in daylight only.

On the other hand, due to the low weight and safety of the Possibly miswritten word instrument, divers may perform their work with less physical effort at any time of the day.

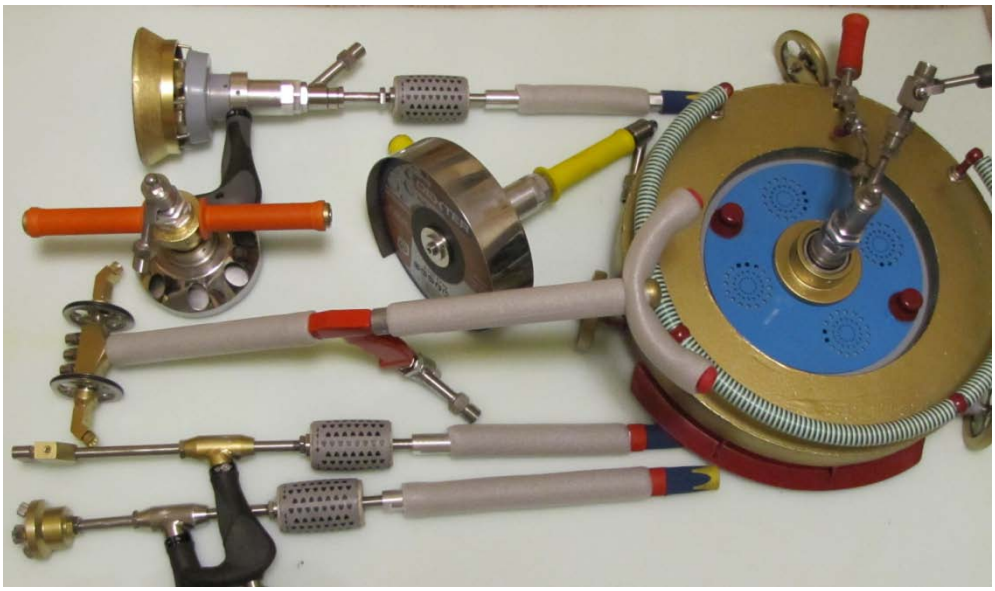
It will take just one run of the instrument to cleanse the surface efficiently, unlike the brush devices, which require several Repetitive word for the same purpose.

One of the Overused word drawbacks of the brush devices is that they fail to function and shut down because of the water-plants rolled over the brush mechanism. Possibly miswritten word instruments Overused word cut all sorts of water-plants.

In Table 1 below you can see the comparative productivity indexes of the two cleansing methods for the tanker with the capacity of 50 000 tons and the under-water area of 10 000 $m^2$ (the comparison is between the one-brush mechanism "Sea Brush" with the productivity of 300 $m^2$/h and the one cavitation instrument).

*Table 1:* Comparative data for the cleansing methods

| INDEXES OF CLEANSING | METHODS OF CLEANSING | |
|---|---|---|
| | "Sea Brush" device | Supercavitation |
| Rated productivity, $m^2$/h | 300 | 250 |
| Actual productivity, $m^2$/h | 100 | 250 |
| Tanker cleansing time, h | 100 | 40 |



Possibly miswritten word instrument CaviMax.

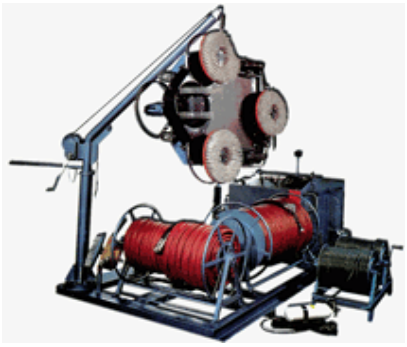
The cavitation driver – "cavitator" is designed in such a way, that it is not damaged during work, as the supercavitation cavern is the working organ and consists of many steam-gas bubbles, which are formed Passive voice outside the cavitation cut.

The brushes require periodical Unusual word pair replacement due to wear ability. The cost of the brush depends on the construction and is in USD, as is shown in Table 2.

*Table 2:* The cost of the "Sea Brush" brushes, USD:

| | | |
|---|---|---|
| Nylon | 45 | for soft accretion |
| Steel | 52 | for soft accretion |
| Steel enhanced | 95 | for hard accretion |
| Steel stainless | 130 | for hard accretion |
| Special | 770 | for very hard accretion |

The abilities and limitations in the application of the old and new technology for the cleansing of various surfaces underwater are given Passive voice in Table 3:



Brush kart

*Table 3:* Comparative capacity and limitations of the given technologies

| Work, abilities, effects | Mechanical "Sea Brush" technologies | Possibly miswritten word device |
|---|---|---|
| Cleansing the ship frame to the "white metal" | Impossible | Possible, time of cleansing extended |
| Cleansing of the king stone grates | Limited | Simultaneous cleansing of all sides |
| Cleansing of the vint and helm group | Limited | Without loss of productivity |
| Cleansing of the underwater parts of the sea-platforms and installations | Impossible | Cleansing of all types |
| Cleansing yachts and boats | Limited | Efficient, the frame surface is not damaged |
| Cleansing small-size objects (devices) and objects with complicated surface | Impossible | Without loss of productivity |
| Number of runs for the instrument to perform the cleansing required | Several (depending on the type and rate of accretion) | One |
| Automation of the cleansing process | Very complicated technically | Realized by PTA installation |
| Cleansing pipes, internal surfaces of the overland industrial surfaces | Impossible | Possible |
| Damage of the protective covers | Inevitable | Absent |
| Environment pollution | Inevitable (toxic elements of ship paint, hydrogear oil) | Absent |
| Waste of materials and instrument wearability | Present (depending on the type and rate of accretion) | Absent |

The comparative properties and productivity of various instruments are given Passive voice in Table 4.

*Table 4:* Comparative productivity data for various instruments

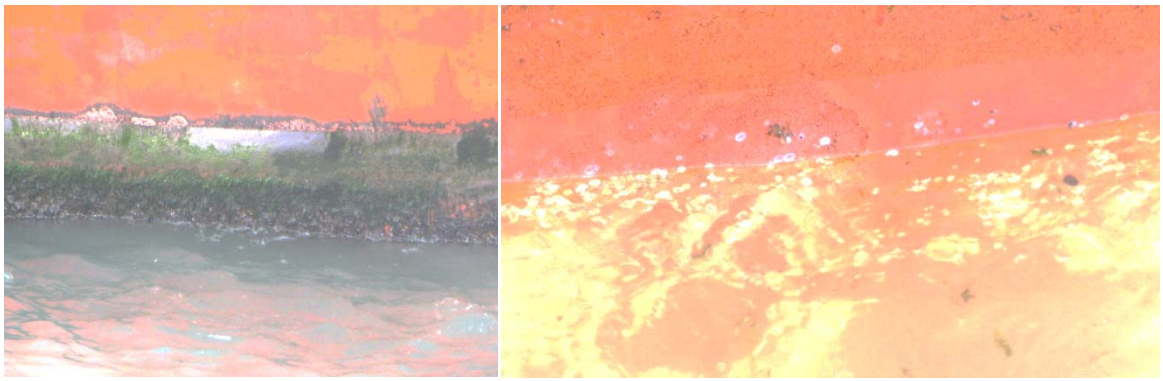
| Category of accretion | Surfaces processed | Old technology $m^2/h$ | | New technology $m^2/h$ | |
|---|---|---|---|---|---|
| | | Scraber | | Sea Brush" head | Hydro pistol |
| I. | Side, bottom | 25 | 800 | 1000 | 200 |
| II. | Side, bottom | 25 | 200 | 1000 | 200 |
| III. | Side, bottom | 10 | 100 | 800 | 150 |

| | | | | | |
|---|---|---|---|---|---|
| | Vint, helm | 2 | 25 | - | 150 |
| | Kingstone grating | 1 | - | - | 150 |
| IV. | Side, bottom | 4 | - | 600 | 100 |
| | Vint, helm | 0.5 | - | - | 100 |
| | Kingstone grating | 0.3 | - | - | 100 |

*Table 5:* Comparative data on the quality of the jobs performed

| Cost of the job 10-15 $/m$^2$ "Sea Brush" | Cost of the job 1-5 $/m$^2$ Possibly miswritten word instrument |
|---|---|
| Damages costly protective paint-and-varnish, anticorrosion and antiaccretion coverings (on the weld seams) due to the contact of the instrument and the surface being cleansed. | Due to the selection of the cavitation flow parameters the accretion cleansing takes place without damaging the protective covering (In some cases cleansing may reach metal). |
| Requires periodical replacement of the mechanical cleansing elements (costly brushes and scrabers), which makes the cleansing process slower and costlier. | Does not require replacement of the working elements quant nozzles), cleansing may be performed in non-stop duration regimen. |
| Non-productive for thick accretion and some types of accretion (like major balanus and long water-plants). | Universal for accretion of any type and thickness. |
| Application in hard-to-reach spots is limited (vint and helm group, kingstone valves, grates, boxes etc.). | The instrument set allows efficient cleansing of all surfaces and hard-to-reach spots. |
| The use of hydrogears may cause leakage of oils and result in the environment contamination. | The technology is environment-friendly, as the overboard water is the single working material. |

Possibly miswritten word instrument *CaviMax.*



Efficient, the frame surface is not damaged.

2. Research and Development Enterprise BUSINESS PROPOSAL

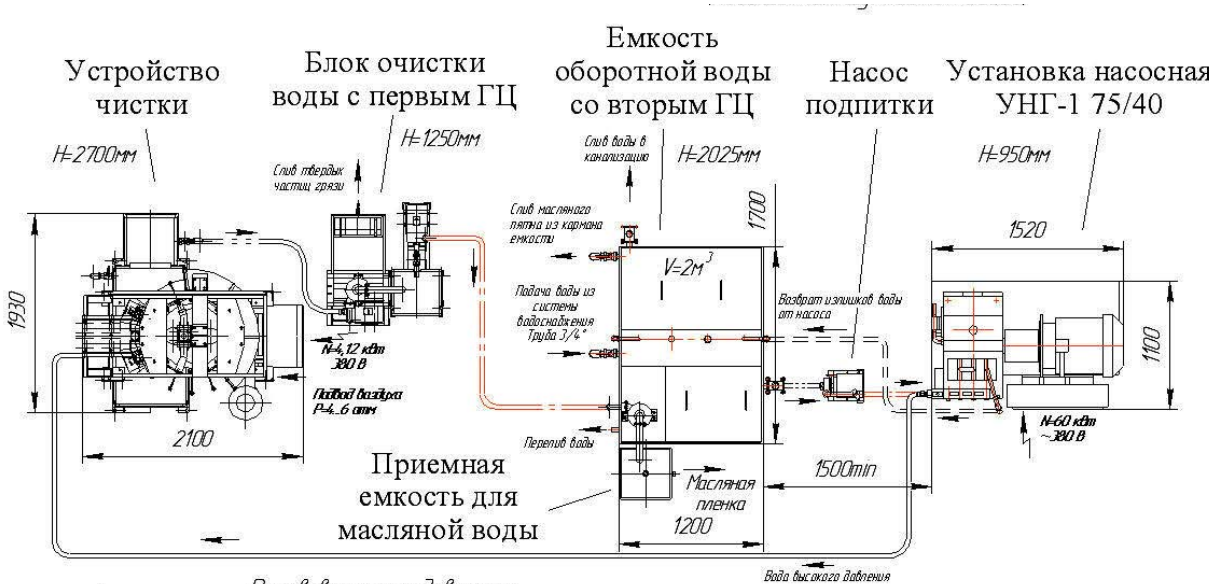
Our company has been operating in the service market for four years already. We design, test, and manufacture plants that are used to clean parts of submerged centrifugal pumps. Our equipment is unparalleled in Russia [1, 2] and the entire world. (The company has an industrial patent “Parts Cleaning Method and the Device Used for Such Cleaning”; the engineering documents and test certificates compliant with the All-Union Standards are also available).

The unit is designed based on the newest *environmentally friendly* technology unparalleled in the world with a special Overused word emphasis on today's efficiency and quality requirements.

The technology used in the proposed unit is hugely advantageous if compared to the more commonly known one that is often applied at repair facilities in Russia and in other countries of the world. The disadvantages of the conventional technology Possibly confused word include the following:

First of all, a commonly known technology Repetitive word involves corrosive and erosive wear of the parts' surface and its undesirable deformation. The parts cleaned in this way are, as a result, quickly discarded. Secondly, the amount of power consumed increases immensely when the parts are cleaned Passive voice. And thirdly, the cleaning efficiency with the technology is rather low.

The proposed Unusual word pair technology eliminates all of the listed drawbacks because the working substance here is water and supercavitation steam-and-gas air bubbles. The cleaning efficiency offered by this technology lies within the range of 50-60 thousand parts per month, provided that the plant is operated Passive voice in two shifts. The plant is a universal semiautomatic device that helps clean pump irrespective of their configuration. The cleaning is performed to 100% at both the inner and outer surface of the Repetitive word with no further cleaning required. The flow diagram of the plant is shown Passive voise in Figure 1.




| Устройство чистки | Cleaning device |
|---|---|
| Блок очистки воды с первым ГЦ | Water treatment unit with the first cyclone |
| Емкость оборотной воды со вторым ГЦ | Recycled water reservoir with the second cyclone |
| Насос подпитки | Delivery pump |
| Установка насосная УНГ-1 75/40 | Pumping plant UNG-1 75/40 |
| мм | Mm |
| Слив твердых частиц грязи | Dump of solid impurities |
| Приемная емкость для масляной воды | Oily water receiving tank |
| кВт | kW |
| В | V |
| Слив воды в канализацию | Water dump into sewage |
| Слив масляного пятна из кармана емкости | Oil patch dump from the tank's pool |
| Подача воды из системы водоснабжения | Water feed from the water supply system |

| | |
|---|---|
| Труба | Pipe |
| Перелив воды | Water overflow |
| Масляная пленка | Oil film |
| Вода высокого давления | High-pressure water |
| Возврат излишков воды от насоса | Return of extra water from the pump |

Parts are cleaned using the developed and patented environmentally friendly technology with the help of supercavitation flows that originate from the system of patented Repetitive word cavitation agents.

The Plant is unique in the way its *environmental friendliness* is achieved Passive voice. The whole principle is based on the *recycled water* that acts as a working cleaning agent, which, after it is used Passive voice, passes through the multi-stage filtration system specially designed for this plant, is then freed from solid impurities, oily additives and paraffin that are collected Passive voice in Overused word tanks, and finally recycled.

*Figure 2:* General Plant View.

*Figure 3:* Water Treatment System.

*Figure 4:* Control Boar.

*Figure 5:* Control Unit.

*Figure 6:* High-Lift Pump.

*Figure 7:* Cavitation Agents Unit.

*Figure 8:* Control over Operation of the Plant s Systems.

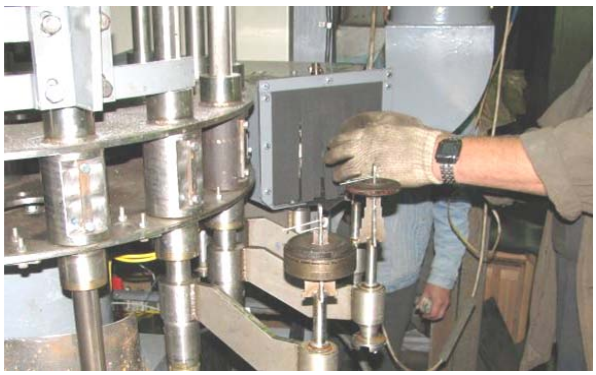


*Figure 9:* Loading of Contaminated Parts for Cleaning and Unloading the Cleaned Parts.

*Figure 10:* Recycled Water in a Tank after the Parts Have Been Cleaned

*Figure 11:* Recycled Water in a Tank after Cleaning in the Filtration System

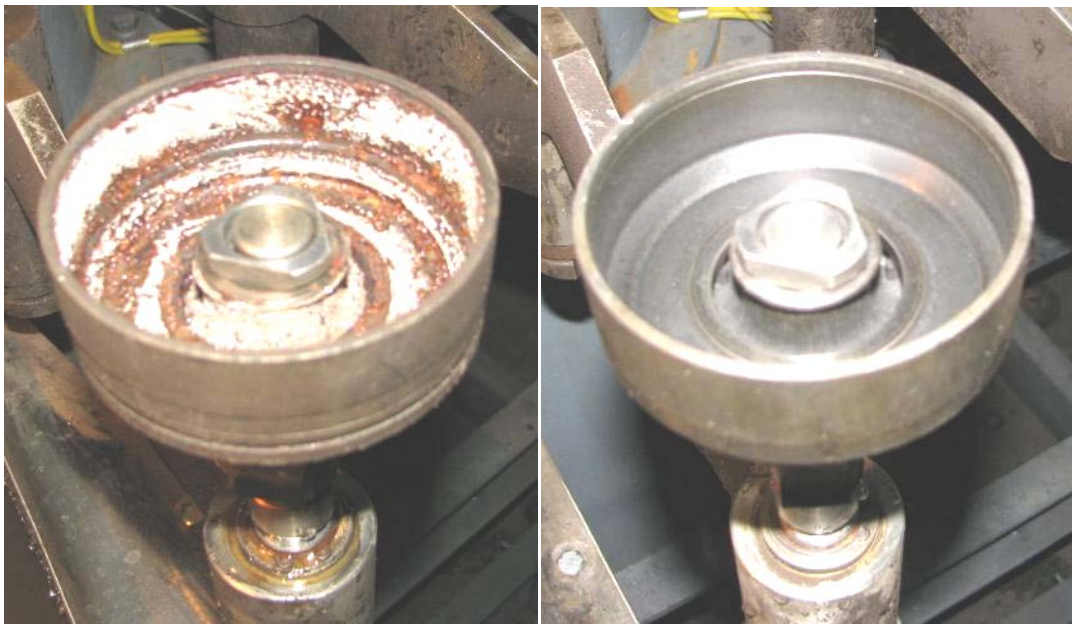


*Figure 12:* Solid Impurities Collection Tank

*Figure 13:* Pump Parts in the Plant Before and After Cleaning

## Literature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