



## OceanSaver<sup>®</sup> Technology description

### 1. Equipment in OceanSaver system

Equipment delivery included in OceanSaver system for typical vessels with two ballast pumps:

- Two filters with 50 micron screen and automatic back flushing.
- Two C3T cavitation units with pressure control after the C3T
- Two gas injection systems consisting of an ejector pump and an ejector
- One compressor and one Nitrogen generator with N2 purity set point 99 %
- One C2E unit producing disinfecting seawater in an electrolysytic cell
- PV valves as replacement of normal air ventilation heads on each ballast tank

### 2. Process description for ballasting operation

See the enclosed 3D P&ID to follow the process. The treatment system is installed as a bypass on the ballast lines so that in emergency cases, ballasting may be conducted without going through the treatment system. OceanSaver rests primarily upon the principle of cavitation and nitrogen supersaturation. In addition – in order to ensure uniform performance as function of the wide range of changing water characteristics experienced in different locations where ballast water may be taken, the processes of filtration and disinfection is included.

#### 2.1 Filter

Ballast water is pumped from sea chest into the seawater filter where most organisms of sizes above 50 micron are stopped. When the backpressure over the filter reaches 0,6 bar, the filter will automatically back flush and the dirty water is piped directly back to sea either in separate line or connected to existing overboard line.

#### 2.2 Cavitation in C3T

After filter the water is then exposed to cavitation in the C3T unit. A cavitation module comprises a number of C3T sub units to deliver the desired capacity.

Standard modules are developed for 200/ 250 m<sup>3</sup>/ hrs; 400/ 500m<sup>3</sup>/ hrs; 700/ 800 m<sup>3</sup>/ hrs and 1000/ 1100 m<sup>3</sup>/ hrs. An individual C3T sub-unit has a capacity range of from approximately 25 to above 40 m<sup>3</sup>/ hrs and a module may be supplied



consisting of up to 32 such sub units. In order to meet a required capacity – duplication of one or different capacity modules may be used.

The C3-T unit's efficiency compared to other cavitation devices is superior creating implosion pressures up to 1000 bar and implosion frequencies of more than 100 kHz.

Unlike conventional cavitation devices, the C3-T concept ensures proximity between system surfaces, particles and organisms and the energy-zone of the imploding bubbles. This represents a major advantage as the released energy can be targeted for the specific use of destroying organisms.

Following cavitation, most all organic matter in the flow will be ruptured and destroyed. The impact causes bacteria colonies to break up into a higher number of "units" – however significantly weakened and vulnerable. Thus, the use of cavitation allows a considerable reduction in disinfectant dosage/ concentration to achieve extinction.

The current C3T unit represents a pressure loss of approx. 3,0 bars and a pressure control valve is required after the C3T unit to keep a constant pressure as required for filling the ballast tanks in all conditions.

### **2.3 Gas injection**

Nitrogen, produced onboard by a membrane-based nitrogen generator, is injected into the main ballast flow in a two stage process. About 10% of the water flow is taken from the main flow and a pump is boosting the pressure through an ejector where Nitrogen with a purity of 99% is mixed into the ballast water. After mixed into main stream again, the ballast water will have an oxygen content in the region of 2 mg/l while normal seawater is in the range of 8 to 11 mg/l.

A low level of dissolved oxygen is assured throughout in the stored ballast water. This prevents potential re-growth during the voyage. This arrangement also catalyses the reduced corrosion effects and the effects this treatment have on reducing oxidation of coatings.



## **2.4 Disinfection C2E unit**

After cavitation and deoxygenation, the system applies a disinfectant produced “inline”.

The C2E module consists of two main units; electrolytic cell stack and electric power supply (rectifier). Both are built into the same standalone cabinet. Cabinet size will differ in height according to system size. The C2E unit takes a small portion of the ballast water flowing through the system just after the ballast pump, typically less than 1.0% and re-injects this into the system just after the deoxygenation where there still is turbulence in the water. The water in the C2E unit is exposed isolated to the anode of the electrolytic cell. This exposure creates a disinfectant consisting of short lived oxidants.

Following cavitation, most all organic matter in the flow will be ruptured and destroyed. The impact causes bacteria colonies to break up into a higher number of “units” – however significantly weakened and vulnerable. Thus, the use of cavitation allows a considerable reduction in disinfectant dosage/ concentration to achieve extinction. The concentration of the C2E disinfectant is kept very low and in combination with its short half-life, its presence has a limited duration and does not impact the positive effects related to coating durability caused by the low level of dissolved O<sub>2</sub> in the water.

No extra pumps are required for the flow through the C2E unit as the pressure difference over the C3T unit supplies the required flow. The dosing is controlled by salinity measurements in the main ballast stream and ORP difference between water in and treated water to the ballast tanks.

## **2.5 PV valve**

In order to maintain level of supersaturation and the low level of oxygen in the water – the conventional tank vent-heads are replaced by pressure / vacuum (PV) valves. This component is also developed by OceanSaver and is the only type approved (by class) P/V valve for atmospheric/ wet applications currently available.

## **2.6 Control system**

The OceanSaver system is including a treatment process control system with required logging system according to IMO regulations.

The valve control system for ballasting may be integrated in the main control system for the vessels ballast control system.



OceanSaver can also supply a separate control system connected to the existing system and require no particular operational attendance for vessels with automated valve control.

## **2.7 Maintenance**

The OceanSaver System is built to ease maintenance by minimizing maintenance intervals and by making maintenance operations as simple as possible.

Maintenance related to filter, compressor and nitrogen plant is assumed reflected in experience from use of similar equipment and is mainly changing of filter cartridges in the compressor and nitrogen generator and filter elements in the filter.

The C2E unit requires electrode washing. This is an automated process but requires simple periodic calibration that can be carried out by the vessels crew.

The C3T unit is designed to last the vessels lifespan (the "housing"). Maintenance of the unit is described in the maintenance manual. The change of torpedoes is a simple operation that can be carried out by the crew.

## **3. Process for discharge**

At discharge, the water is pumped out of the vessel, filtered and cavitated through the C3T module. In order to reach the IMO D-2 Ballast Water Performance Standard, further treatment is not necessary. In order to reach an even higher performance requirement, the water may be added the C2E disinfectant at discharge also.

**OceanSaver<sup>®</sup>**

**NITROGEN GENERATOR**

**PV VALVE**

**AIR COMPRESSOR**

**FILTER**

**C2-E**

**EJECTOR PUMP**

**C3-T**

**EJECTOR**

**Ballast Water Treatment System**

