DUPONT™ MARINE SCRUBBER
EXHAUST GAS CLEANING SYSTEMS
FOR MARINE ENGINES & BOILERS

DuPont Sustainable Solutions
marinescrubber.dupont.com
ENGINEERING CLEAN AIR FOR OVER 40 YEARS

BELCO TECHNOLOGIES CORPORATION (BELCO)

BELCO, a DuPont Sustainable Solutions company, specializes in reliable air pollution control systems to meet clean air regulations with minimal maintenance and operational requirements. For over 40 years, BELCO engineering and process experts have designed, customized, built, and delivered reliable and efficient exhaust gas cleaning systems for SOx and particulate reduction, as well as control of other pollutants and mists, across a wide range of demanding applications.

DUPONT SUSTAINABLE SOLUTIONS

Sustainable Solutions is a DuPont business unit with innovative technologies to help enhance health and safety, improve operations efficiency, and deliver competitive advantage. DuPont tailors industry-proven process technologies to help your organization reduce emissions and increase profitability. We implement breakthrough technologies and solutions across numerous complex processes, driving business growth.

DuPont is a global company with presence in over 90 countries and certified fabricators worldwide. DuPont (NYSE: DD) has been bringing world-class science and engineering to the global marketplace in the form of innovative products, materials, and services since 1802.

The COMMODORE CLIPPER – Car, passenger and freight carrier with two DuPont™ Marine Scrubbers
EXHAUST GAS CLEANING SYSTEMS FOR MARINE ENGINES & BOILERS

DESIGN PHILOSOPHY
Let customers concentrate on operations, not the control of emissions.

BELCO engineers design the DuPont™ Marine Scrubber to be the slimmest, most reliable equipment on the market. Our systems operate maintenance-free for extended periods of continuous operation to match or exceed periods between normally scheduled dry-docks. We have minimized moving parts to reduce maintenance issues.

SCRUBBER FEATURE | DESIGN BENEFIT
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SLIM PROFILE | Allows the scrubber to fit in existing funnel casing
EFFECTIVE NOISE REDUCTION | Replaces the silencer
“RUN DRY” CAPABILITY | Safely exhaust through scrubber even when it is offline
NO BYPASS REQUIRED | Reduces the space and ducting requirements
LOW PRESSURE DROP DESIGN | Scrubber meets the engine manufacturer’s back pressure requirements
NO FANS REQUIRED | Fewer maintenance issues
NO WATER RETENTION | Low weight; minimal impact on ship stability

DIAGRAM OF A TYPICAL HYBRID SCRUBBER INSTALLATION
FLEXIBLE DESIGN FOR ANY INSTALLATION

<table>
<thead>
<tr>
<th>SCRUBBER TYPE</th>
<th>FEATURES</th>
<th>RECOMMENDED USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN LOOP</td>
<td>• Uses natural alkalinity of seawater as buffer on a once-through basis</td>
<td>• Open seas with high to moderate alkalinity</td>
</tr>
<tr>
<td></td>
<td>• No fresh water or reagent required</td>
<td></td>
</tr>
<tr>
<td>CLOSED LOOP</td>
<td>• Minimal make-up water required</td>
<td>• Waters with low alkalinity – estuaries, ports, harbors, lakes, canals and inland waterways</td>
</tr>
<tr>
<td></td>
<td>• Process buffered with reagent addition</td>
<td>• Areas where no discharge is allowed</td>
</tr>
<tr>
<td>HYBRID</td>
<td>• Open loop and closed loop capability</td>
<td>• Use everywhere</td>
</tr>
<tr>
<td></td>
<td>• Most flexible design</td>
<td></td>
</tr>
</tbody>
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INLET CONFIGURATIONS TO MEET THE NEEDS OF ANY VESSEL

SINGLE-STREAM INLET
ONE EXHAUST GAS SOURCE VENTS TO A DEDICATED SCRUBBER
• Low installation costs in retrofits
• Requires minimal changes to existing ductwork
• Optimizes each scrubber for dedicated exhaust source
• Fits in funnel where height is limited

MULTI-STREAM INLET
MULTIPLE EXHAUST GAS SOURCES VENT TO A COMMON SCRUBBER
• Fits where multiple smaller scrubbers do not if funnel space is limited
• Reduces number of installed scrubbers
• Reduces onboard auxiliary equipment
• May reduce system cost
The A.P. Møller – Maersk Group (Maersk) trusted DuPont™ Marine Scrubber technology for its first exhaust gas cleaning system installation. The hybrid scrubber was installed on the TUKANG, a container ship with capacity exceeding 8,000 TEU. The system has successfully achieved IMO Annex VI compliance.

**SUITABLE FOR RETROFITS AND NEW BUILDS**

A scrubber can be installed as a retrofit or on a new build vessel. Early adopters of scrubber technologies are likely to see greater financial benefits and to see them sooner.

**RETROFITS**

The slim design of the DuPont™ Marine Scrubber makes it a natural choice for a retrofit. The vessel’s weight, height, and diameter will allow the scrubber to fit in the vessel without major modifications.

**NEW BUILDS**

DuPont can work with your builders to seamlessly integrate the marine scrubber system into the ship during the design phase, saving time and money.

DuPont™ Marine Scrubbers have been ordered and delivered on a wide range of vessels, from container ships to ferries, to dry bulk carriers.

The DuPont™ Marine Scrubber gets installed on a self unloader dry bulk carrier. The existing funnel casing was not disturbed and it fully enclosed the slim scrubber vessel.

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“While postponement of the sulphur global cap until 2025 is still a possibility… ICS has concluded that, for better or worse, the global cap is very likely to be implemented in 2020, almost regardless of the effect that any lack of availability of compliant fuel may have on the cost of moving world trade by sea”.

MASAMICHI MOROOKA
ICS Chairman, 5 Feb 2015

The DuPont™ Marine Scrubber enables any vessel to meet SOx emission limits without switching to expensive low sulphur fuel.

Depending on the price differential between HFO and MGO, as well as time spent in an Emission Control Area, a scrubber can be an excellent compliance solution with a reasonable payback of less than two years.

For the 2020 Global Sulphur Cap of 0.5% S fuel, a scrubber is the most affordable, lowest-risk option.

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IMO MARPOL EMISSION CONTROL AREAS

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