

Underwater Robotics

Passionate for Robotics Technology



Path to redefine underwater hull cleaning service without disruption

Introduction

Passionate for Life, for Customer, for Robotics Technology



Ocean is a beautiful place but harsh if not treated with respect.

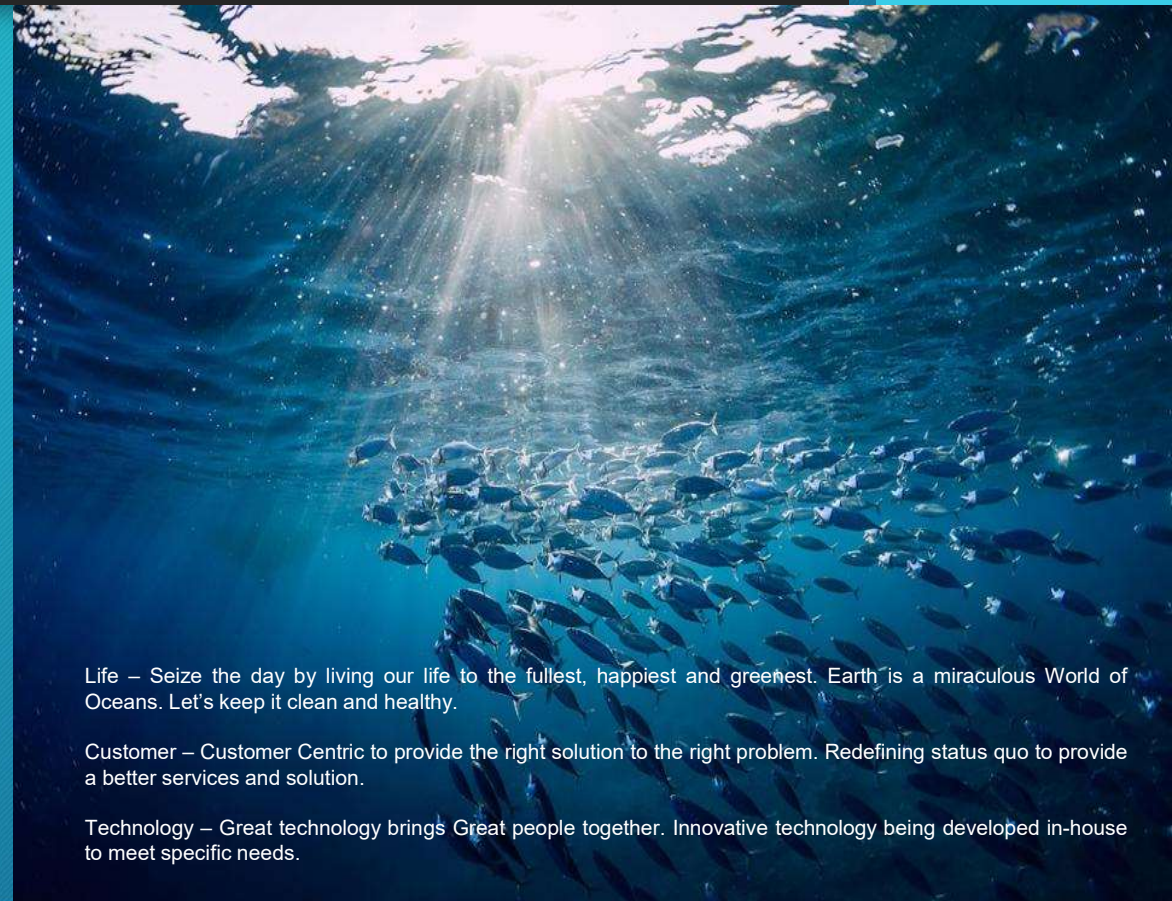
Implementation of robotics technology in general has been in an upward trend for Land, Air and Sea.

ROV – Remote Operated Vehicle technology started off in 80s and is now widely implemented in the general offshore industry up to a depth of 3000m. Scientific projects can be up to a depth of 6000m or more.

Inland water though shallower, has another set of unique challenges which require innovative solutions.

Underwater robotics technology is more complementary to commercial diving than disruptive.

- Today, we will use hull cleaning as an example.



Life – Seize the day by living our life to the fullest, happiest and greenest. Earth is a miraculous World of Oceans. Let's keep it clean and healthy.

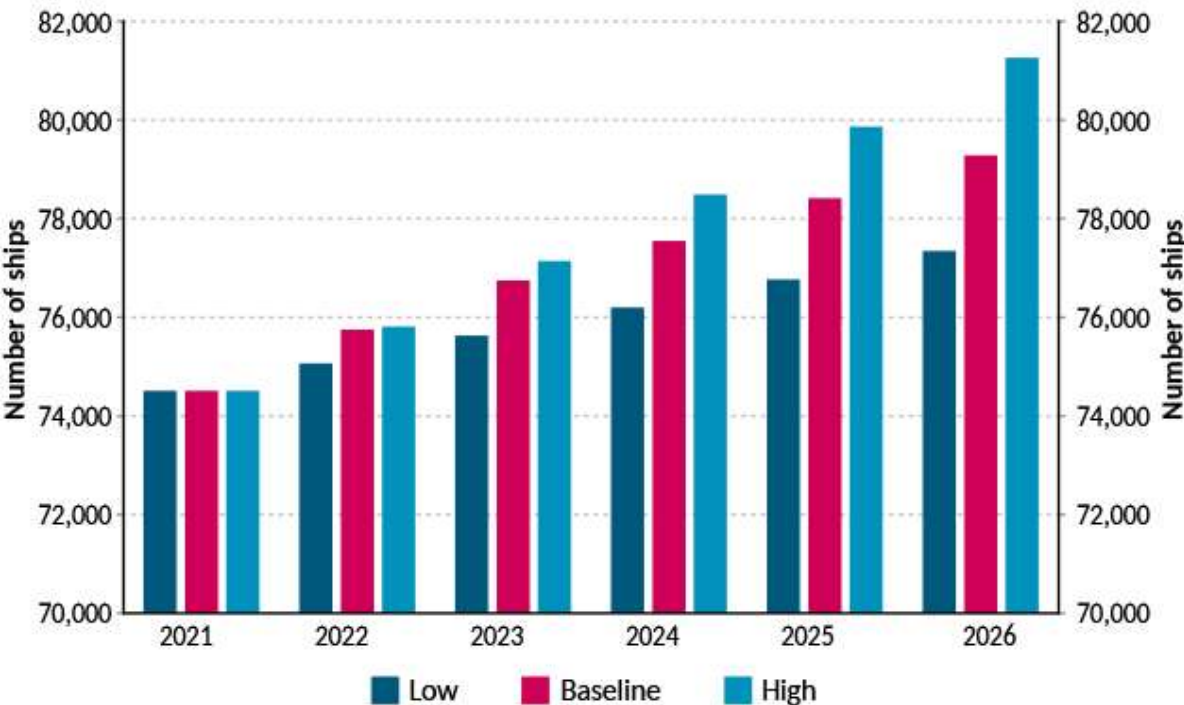
Customer – Customer Centric to provide the right solution to the right problem. Redefining status quo to provide a better services and solution.

Technology – Great technology brings Great people together. Innovative technology being developed in-house to meet specific needs.

Global Hull Cleaning Market



Forecast growth in the world merchant fleet
2021-2026



Source: BIMCO

Note: Number of ships at the start of period specified.
Existing fleet and current orderbook is basis IHS Markit.

Market overview

- There are 62,000 merchant ships in 2020.
- Major ports for hull cleaning include Singapore, Busan, Rotterdam, Jebel Ali, San Francisco etc.
- Singapore has an average of 10,000 vessels stopover every month.

General trend

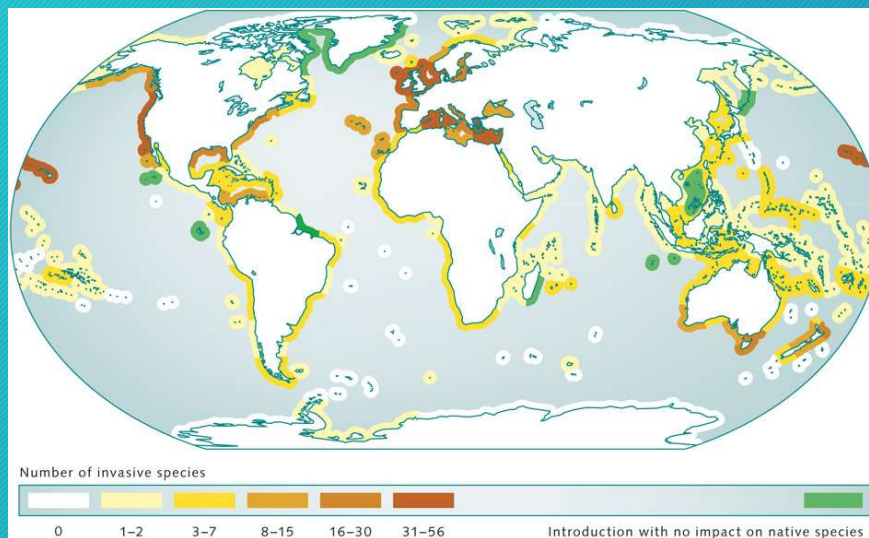
- Positive organic growth.
- Increase demand for robotics solutions with in-water capture systems.
- More stringent decarbonization regulations and policies. **Hull cleaning is a major contributor to maritime industry decarbonization effort.**

Hull cleaning is a part of the Maritime decarbonization effort



- However, to be considered a full environmentally friendly solution, need to take bio-fouling management into consideration.

Invasive species thrive particularly well in certain coastal ecoregions of the Earth. Most affected are the temperate latitudes. Regions where immigrants do not encroach on or displace native species are shown in green



[Italy declares war on invading Atlantic blue crabs, by dishing them up \(yahoo.com\)](#)

[5 Invasive Species You Should Know | Smithsonian Ocean](#)

[Invasive species « World Ocean Review](#)



Example of invasive marine species

Underwater hull cleaning/grooming services



- Each region/country has independent regulations, governing the industry.
- Certain countries, such as Australia, New Zealand, US (Hawaii & California), Holland, Norway, Sweden, and Denmark, have stringent regulations regarding hull cleaning practices.
- BIMCO (Baltic and International Marine Council) introduce a standard in 2021, putting great emphasis on capturing biofouling removed from the ship, thereby ensuring that the marine environment is not negatively affected.
- Proactive hull cleaning of ISO TC8/SC2 work group form in Q1 2023. Singapore is an active participant with SMF-SDO, ESG, MPA and industry experts
- Traditionally done by divers with brushkarts.
- There is already a wide range of underwater robotics solutions in the market, mainly from Europe and Asia.

The need for an international industry-led standard

BIMCO



HULL CLEANING
CUTS CO²
EMISSIONS BY
35%

The organisms growing on the ship increases its drag through the water leading to higher fuel bills and higher CO² emissions. It is therefore important to remove the growths every couple of years.



50,000
MERCHANT SHIPS

The 50,000 merchant ships trading internationally transported 11.1 billion tons of cargo in 2019. 7.9 billion tons of that was dry cargo, such as grain, coal and iron ore.



PARTICLES WITH
DIAMETER >
**0.001
mm**
CAPTURED

Using the standard, cleaners will capture the vast majority of particles down to microscopic size (0.001 millimeters), reducing risk of ocean pollution.

SPECIALIST
Cleaning
COMPANIES

Standard would establish a benchmark for safe and environmentally sound cleaning by local specialist companies.



Holistic view of Singapore underwater services



Why Singapore need underwater robotics in our industry?

- Labour shortage – both local and foreign
- Risk aversion – harsher environment at anchorage. Low visibility and strong current.
- Underwater work in Port terminal – ROV only
- Electrification and Autonomous trend may have a significant impact from a long-term perspective.



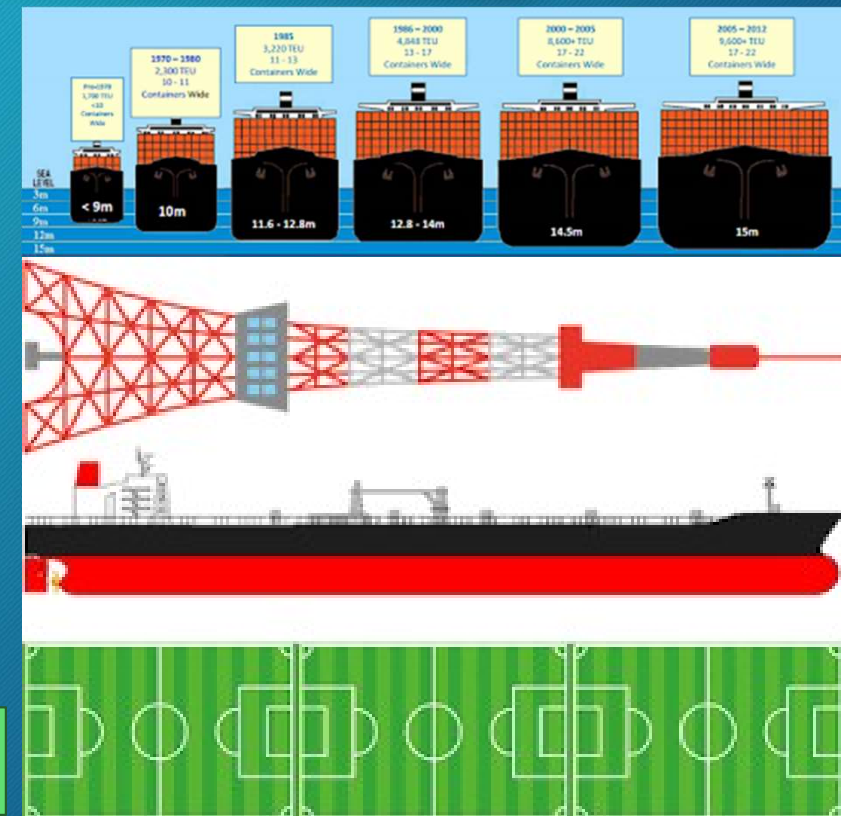
Complementing diving operation



- Underwater robotics technology now and in the near future is not able to completely do what humans can do underwater.
 - ROV can clean only flat and slight curvature areas. Cannot do niche areas and Propeller polishing.
 - Underwater repair work.
- Cleaning mega size vessel is very physically demanding.
- Increase efficiency and reduce risk through the hybrid solution.
 - Deep draft, megasize ships and cleaning in port terminal.

As a service provider, our biggest threats are not each other but passive marine growth inhibitor technology.

How can Singapore provide a fast, safe and environmentally friendly hull cleaning solution? This is a journey both Diving and ROV can take together.



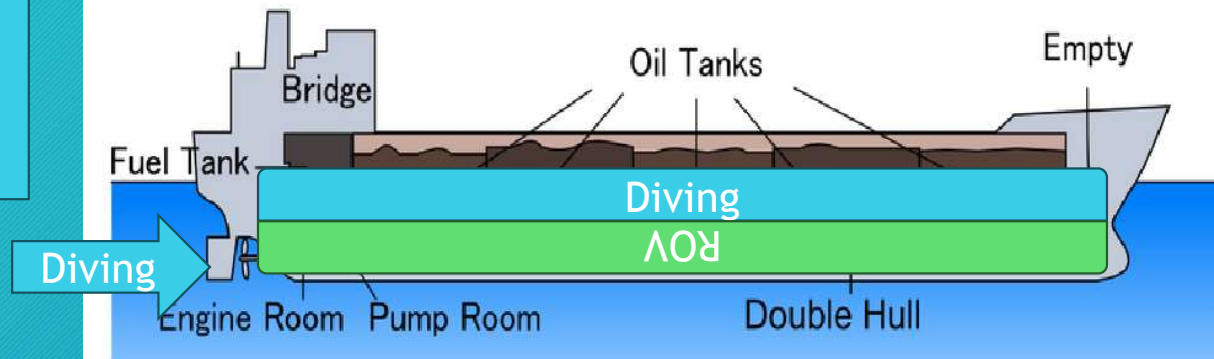
Complementing diving operation - example



Diving

- Vertical sides within 12m depth
- Niche Areas
- Propeller polish
- Daylight

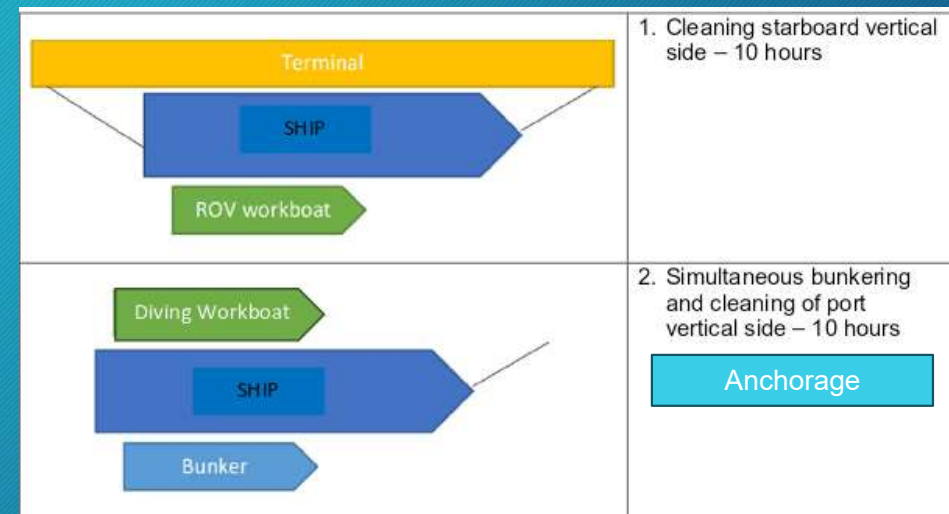
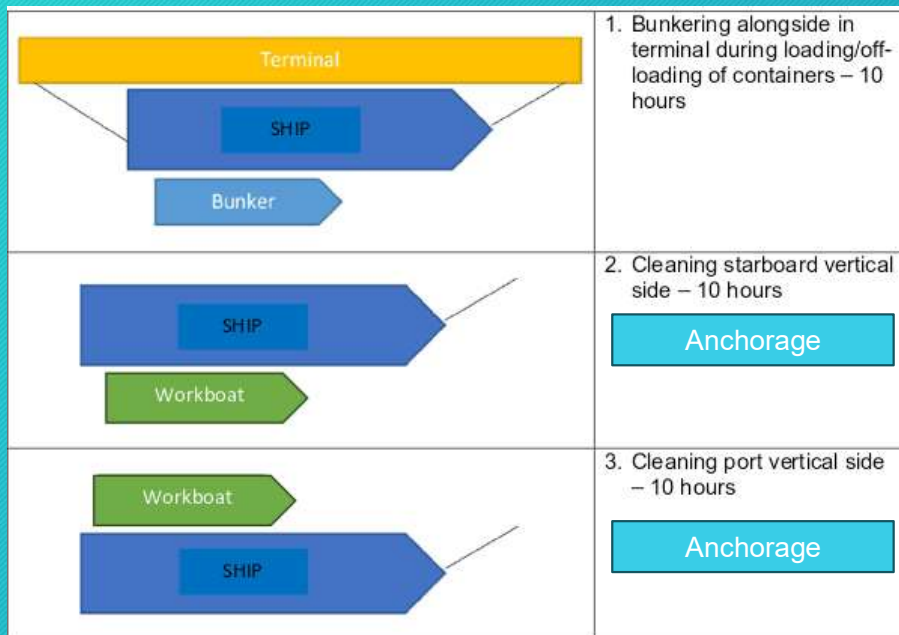
Oil tanker (side view)



ROV

- Vertical sides beyond 12m depth
- Flat Bottom
- Night time

Complementing diving operation - example

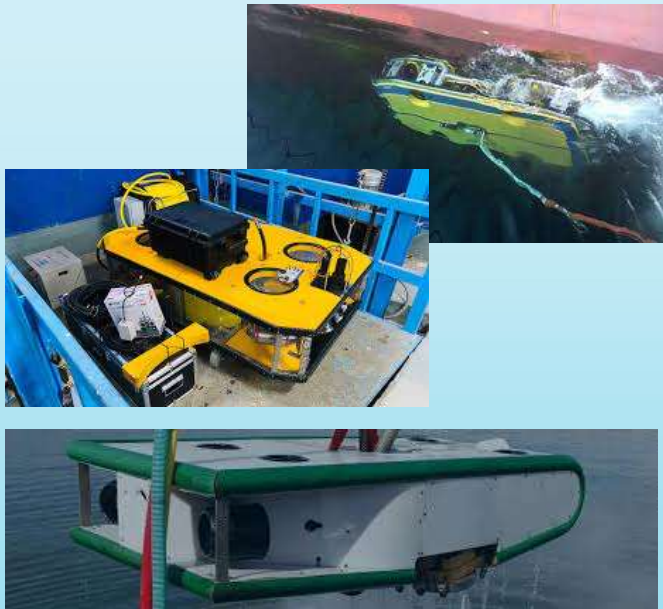


Leveraging on each other strength to maximize efficiency thus making Singapore the most ideal location to conduct underwater hull cleaning.

Example of Underwater hull cleaning ROV



Stopover cleaning



Free flyer



Crawler

Transit cleaning



Example of Underwater hull cleaning ROV



Underwater hull cleaning

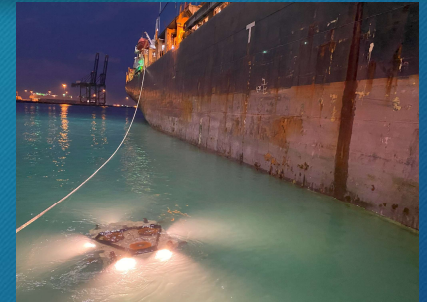
1. Water jetting
 - Pressure can range between 2500 psi to 20k PSI
 - Within 3000 PSI is effective for light fouling
 - 3500 to 6500 PSI is effective for medium fouling, coating may be removed.
 - 10K to 20K is effective for heavy fouling, coating will be removed.
2. Cavitation
 - From coating protection perspective, this is the safest but also the slowest.
 - Need to position the nozzle at an angle and close to be effective.
 - Risk of nozzle scratching the hull at curvature if not position-designed properly.
3. Brushes
 - Most versatile and efficient, can vary the brush to suit different requirements.
 - Assist to activate some of the coating anti-fouling properties.
 - Risk of damaging coating if use the wrong brush and/or wrong pressure applies on the hull.



Example of Underwater hull cleaning ROV



- UCM series is an inhouse designed and build ROV system.
- Patented Underwater cleaning with surface torque control ROV system.
- Comes with in-water capture and filtration system.
- Can clean all types of marine growth.

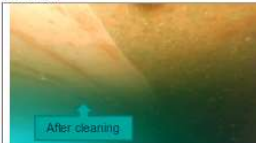


HYDROV
PASSIONATE FOR LIFE, CUSTOMER & ROBOTICS TECHNOLOGY

Leveraging on decades of underwater experience and passion for robotics technology, we strive to redefine status quo to improve safety and efficiency through our patented inhouse design Hull cleaning ROV (UCM series) with surface torque control system.

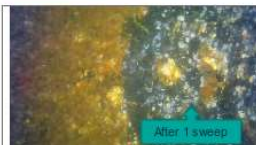
CLEANING REDEFINED

Results:



Example 1: Light cleaning to maintain optimal hull performance

Fiat bottom cleaning of a container ship. UCM200 ROV overlapping cleaned portion to ensure the entire area of biofouling will be removed.

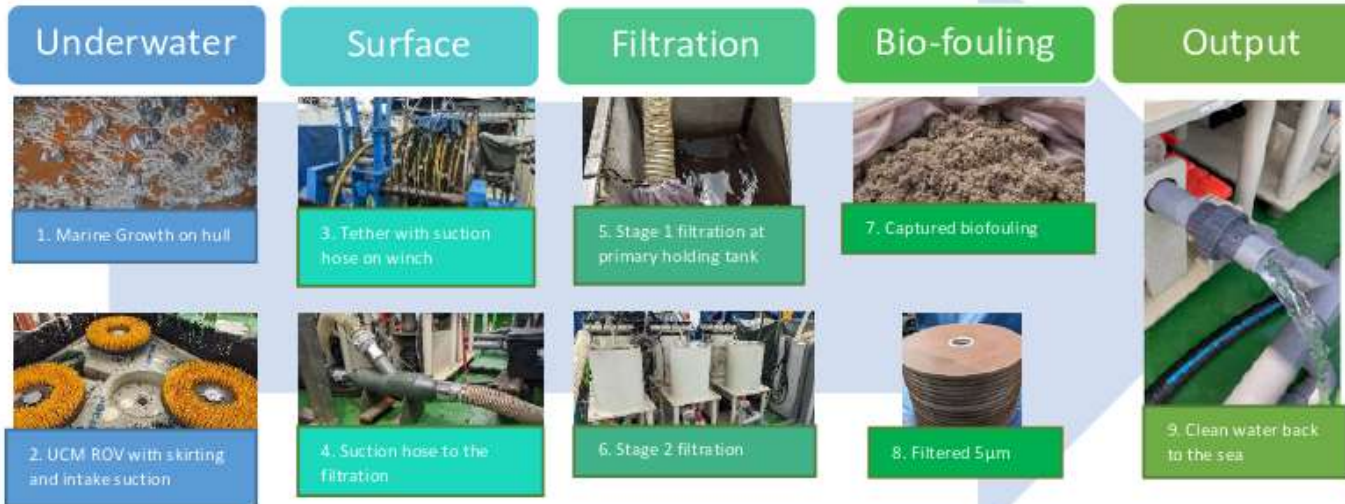


Example 2: Heavy cleaning prior to Dry docking

This barge was heavily covered with dense marine growth. The client wants all marine growth to be removed before going dry dock. UCM200 ROV took multiple sweeps to remove all marine growth from the hull.



Biofouling management



On analysis, the following results were obtained:

Test	Method	M/V: SPINEL (Bulk Carrier) LOA 200M (Hydrov UCM Reclaim system)		
		Seawater	Filter Tank	After Filter and Discharge Back to sea
Colour (Lovibond Manual), 1" cell	Lovibond Manual	<1	<1	<1
pH value @ 25.2°C	APHA 4500 H ⁺ B	7.9	7.8	7.5
Chemical Oxygen Demand, mg/L	APHA 5220 B	40	38	36
Total Suspended Solids, mg/L	APHA 2540 C	<5	10	<5
Iron (Fe), mg/L	APHA 3120 B	<0.1	ND (<0.1)	ND (<0.1)
Copper (Cu), mg/L	APHA 3120 B	0.5	<0.1	ND (<0.1)
Lead (Pb), mg/L	APHA 3120 B	ND (<0.1)	ND (<0.1)	ND (<0.1)
Zinc (Zn), mg/L	APHA 3120 B	0.8	<0.1	ND (<0.1)

Remarks: 1) APHA - American Public Health Association, "Standard Methods for the Examination of Water and Wastewater", 23rd Edition, 2017.
 2) Sea Water sampling was taken on 24 Nov 2022 at Singapore anchorage Location AESPA.
 Sea Water Sample bottle 1 taken in Hydrov UCM reclaim system to storage tank.
 Sea Water Sample bottle 2 taken from the discharged of our filtration system.
 Sea Water Sample bottle 3 was taken from the vessel anchored area.
 3) ND - Not detected; < - Less than

Low Ai Fang
Chemist

Than Than Win
Assistant Manager
ANALYTICAL LABORATORIES (S) PTE. LTD.

UCM200 ROV system also comes with an optional in-water capture/ filtration system up to 5µm.

Most of the marine growth and particles we cleaned off the hull will be brought up to the surface and only clean filtered water is released back into our ocean.

Thank You



Email: jamesho@hydrovsg.com

Website: www.hydrovsingapore.com

LinkedIn: [\(13\) HYDROV SINGAPORE PTE LTD: Overview | LinkedIn](#)

