

# COMBINATION OF AIR LUBRICATION AND SUPER HYDROPHOBIC FRICTIONAL DRAG REDUCTION

Tech ID: 29227 / UC Case 2018-118-0

## PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,780,533	10/10/2023	2018-118
European Patent Office	Published Application	3833878	06/16/2021	2018-118

## BRIEF DESCRIPTION

This technology combines air layer frictional drag reduction (ALDR) with super hydrophobic surfaces (SHS) to achieve frictional drag reduction of ALDR with significantly reduced gas flux. Thus, enabling increased net energy savings. The stable air layer is achieved with lesser gas flux when utilizing a SHS.

Periodic air layers may replenish SHS, enabling drag reduction with reduced energy cost.

Combinations of SHS and regular or other non-SHS surface may be used to control spreading of gas, thus facilitating formation of ALDR using discrete gas injection points better than previously achievable. Such surface variations could also be used to preferentially guide gas towards or away from propulsion, depending on desired outcome.

By controlling ALDR regionally or globally on a surface, with or without SHS, this technology modifies flow around a hull. This mediates forces on partially or fully submerged objects, enabling control of flow patterns, resistance, steering, and/or dynamics.

## SUGGESTED USES

Ship owners could potentially save 100k to 1M per year per ship in fuel, if this works as planned. Compared to ALDR alone, would significantly reduce cost to retrofit ship as smaller piping and compressors required. Savings of ~500k to ~2M per ship.

Can enable increased ship speed (e.g. pleasure yacht and military applications).

Control of air flow to propulsor region can be used to reduced vibrations and noise.

For pipelines and chemical plants etc, potential for >10% pumping cost savings. For large pipelines, millions in USD and much reduction in carbon footprint (similar to benefit for ships). Also, reduced pumping cost and lower dp means can have lower p\_max and have big safety impact.

Can be used for any vehicle/device operating in liquid or transferring liquid (UUV, ROV, WEC, tidal turbine, ship, torpedo, submarine, pipeline, etc.)

## ADVANTAGES

Frictional drag accounts for approximately 60% of a typical cargo ship's propulsive power requirements. By combining two previously studied frictional drag reduction techniques, this technology significantly reduces a ship's frictional resistance, offering substantial economic and environmental advantages.

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## INVENTORS

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## OTHER INFORMATION

### KEYWORDS

frictional drag reduction, friction, drag reduction, hydrophobic

### CATEGORIZED AS

- » **Energy**
- » Transmission
- » **Materials & Chemicals**
- » Other
- » **Security and Defense**
- » Other
- » **Transportation**
- » Other
- » **Engineering**
- » Other

### RELATED CASES

2018-118-0

By itself, air layer frictional drag reduction (ALDR) can save a ship about 20% in propulsive power, but the net energy savings are typically less than 10% due to energy required to supply the gas.

Super hydrophobic surfaces (SHS) also do not robustly reduce the frictional drag in turbulent flows over extended periods of time. Among the challenges, gas trapped on an SHS is lost over time and needs to be supplemented.

RELATED MATERIALS

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