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HERDERS – BACKGROUND INFORMATION

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Oil Spill Response

Basic Requirements

- Oil layer thickness must be at least 2 to 3 mm (0.08–0.12 in) to sustain combustion
- Oil must have some volatiles and not contain too much water
- Winds can't be too high – "blows out the candle"

EFFICIENCY OF IN-SITU BURNING

- Efficiency of a burn depends on the oil thickness
  - "Chimney effect" (wind herding) thickens oil during burn
- Thick oil layers can burn at a rate of 2.5 mm/minute (1 inch in 10 minutes).
- Burn rate limits burn times to 10 – 20 minutes for **free-floating oil slicks** thereby mitigating the potential hazard of uncontained oil fires
- Combustion normally continues until the final thickness is approximately 1 mm, burn efficiencies for free-floating oil slicks in excess of 90% can be achieved

IPIECA / IOGP, 2016, Controlled In-situ Burning of Spilled Oil, International Association of Oil & Gas Producers, IOGP Report 523.

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What are herders?

A chemical product that contains a surface active agent which acts on the water surrounding an oil slick and causes the oil to thicken.

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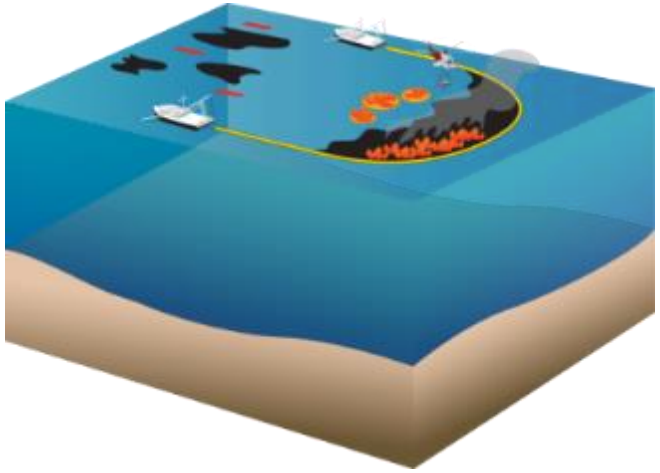
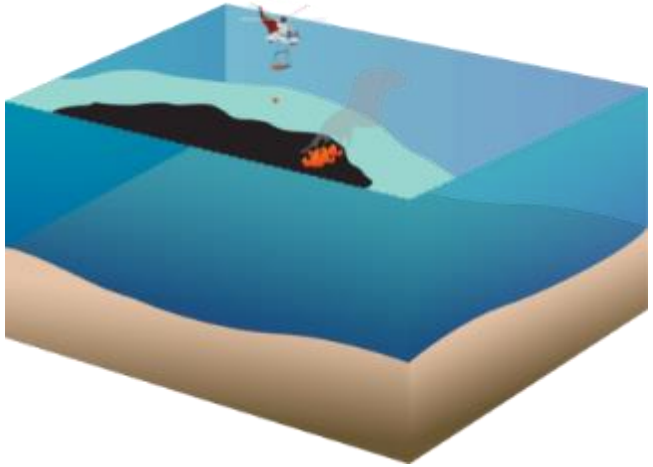
Technology Description

- Herders use a ‘surfactant boom’ to thicken slicks—no boundary required (Garrett & Barger, 1972)
- Herders typically require at least an order of magnitude less product than treating slicks with dispersants (Buist et al., 2014)
- Herder technology originally developed for open water (Garrett & Barger, 1972); in 2000’s research focused on marine applications with ice; but more recent research has again concentrated on open water (Cooper et al., 2017; Buist et al., 2011)
- The goal is to have another tool that can be rapidly applied to make ISB a routinely used response option





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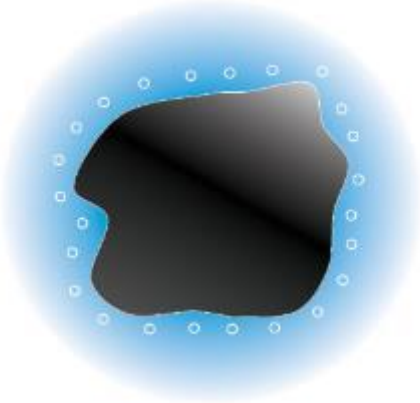
Technology Description



Herders sprayed on water around perimeter of slick via aircraft, boat, USV

Herders rapidly spread to form monolayer of surfactant on water surface

Herders change surface tension of water forcing slick into smaller area

Biodegradable surfactants applied to water around slick perimeter re-thicken slicks to support combustion

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Test tank demo

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Prior Research

- Over 15 years of research has proven that herders for ISB works
  - Most development performed under temperate, open-water conditions = not just Arctic!!!
- Herders have been formulated to be low toxicity and rapidly biodegradable, e.g., Thickslick™ 6535 herder
- Herders may work in sea states greater than boom as the surfactants reduce wave cresting – Garrett & Barger (1972) kept a slick herded for 2.5 hours in 6 foot seas with numerous white caps
- Two herders (ThickSlick™ 6535 and Sil-Tech OP-40) are listed on the EPA NCP schedule for potential use in US waters: THICKSLICK 6535 | US EPA

Results of EPA Required Toxicity Testing for NCP Listing

Herder	Menidia beryllina (minnow) 96 hr LC_{50}	Mysidopsis bahia (shrimp) 48 hr LC_{50}
Thickslick™	138 ppm (practically non-toxic[a])	286 ppm (practically non-toxic[a])

[a]as defined by the US EPA aquatic toxicity ranking system (http://www.epa.gov/espp/litstatus/effects/redleg-frog/naled/appendix-i.pdf)

Results of Biodegradation Testing

Herder	% biodegradation Day 1	% biodegradation Day 20
Thickslick™	14.8	>99

Garrett, W.D. and Barger, W.R., 1972. Control and Confinement of Oil Pollution on Water with Monomolecular Surface Films, Naval Research Laboratory, Washington, D.C., NRL Memorandum Report 2451.

Field Testing – Offshore Norway 2016 (Cooper, 2017)

Control slick with no herder application 50 minutes after release

Slick after Herder application / before burn

- Field test conducted June 14, 2016
- First known study to successfully burn free-floating marine oil slicks in open water
- Herded slick burned for <15 min.
- Control slick (no herder) burned for <10 min and required multiple ignitions.

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Application Requirements

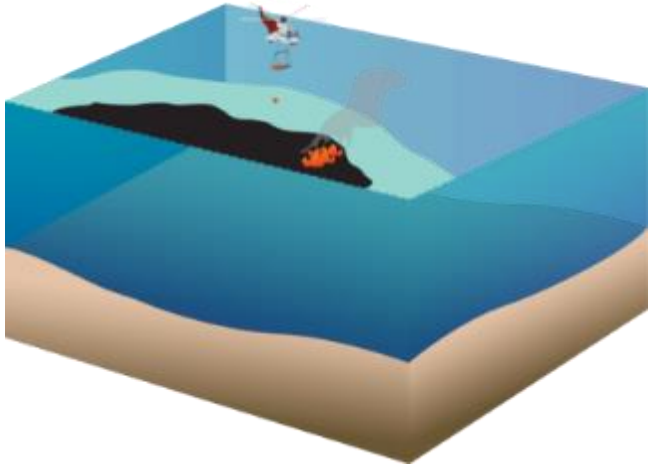
Herders were successfully used in a field test in 2008 offshore Svalbard.

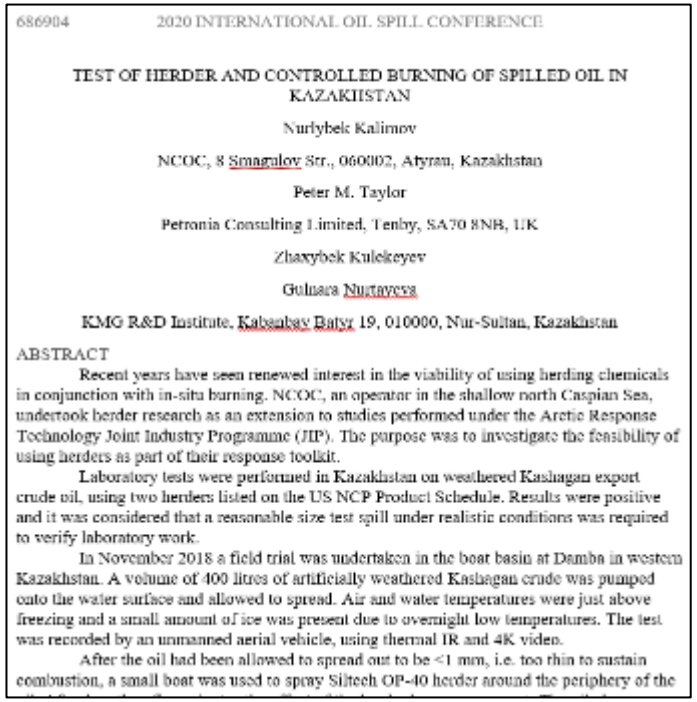
Herders enabled in situ burning during a 2016 field test offshore Norway. Left photo shows herded slick and right photo show unherded slick.

- Sea state window is unknown
- Suitable for low to medium viscosity oils
- Only suitable on fresh or weathered crude oil
- Oil must have lower spreading pressure than the herding agent
- 5 L/km as a linear dosage; So, a 1 km^2 slick would have a radius of 0.56 km and a circumference of 3.5 km. This means you only need <20 L to treat.
- Low toxicity and used in extremely small quantities = more than 30 times less than the design application rate for dispersants

Potential use case scenarios

- In Situ Burning = "*Herd & Burn*"
- Recovery = "*Herd & Skim*"
- Chemical boom = "*Herd & Deflect*"
- Example:
  - Norther Caspian shallow water areas, reed beds
  - 2018 trial in Damba basin to test
  - Herders approved for use by Kaz regulator
  - NEBA driven use
    - Too shallow for dispersants
    - Speed of application





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TEST OF HERDER AND CONTROLLED BURNING OF SPILLED OIL IN KAZAKHSTAN

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ABSTRACT

Recent years have seen renewed interest in the viability of using herding chemicals in conjunction with in-situ burning. NCOC, an operator in the shallow north Caspian Sea, undertook herder research as an extension to studies performed under the Arctic Response Technology Joint Industry Programme (JIP). The purpose was to investigate the feasibility of using herders as part of their response toolkit.

Laboratory tests were performed in Kazakhstan on weathered Kashagan export crude oil, using two herders listed on the US NCP Product Schedule. Results were positive and it was considered that a reasonable size test spill under realistic conditions was required to verify laboratory work.

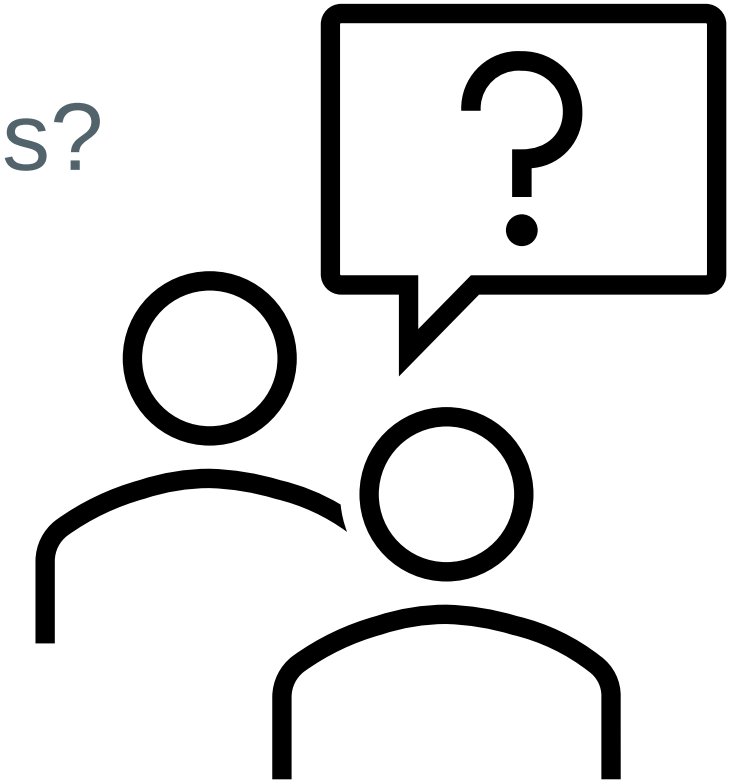
In November 2018 a field trial was undertaken in the boat basin at Damba in western Kazakhstan. A volume of 400 litres of artificially weathered Kashagan crude was pumped onto the water surface and allowed to spread. Air and water temperatures were just above freezing and a small amount of ice was present due to overnight low temperatures. The test was recorded by an unmanned aerial vehicle, using thermal IR and 4K video.

After the oil had been allowed to spread out to be <1 mm, i.e. too thin to sustain combustion, a small boat was used to spray Siltech OP-40 herder around the periphery of the

Application techniques

- Near shore with simple garden sprayers, hand pump sprayers or squirt cans
- Commercial backpack sprayer (small boat application system)
- Boat spray systems
- Manned helicopter and remote-controlled helicopter with the DESMI-AFTI aerial application system
- Remotely operated surface vehicle (ROSV jet ski)

Questions?



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