Can a Polymer Help Curb Arctic Ice Melting?

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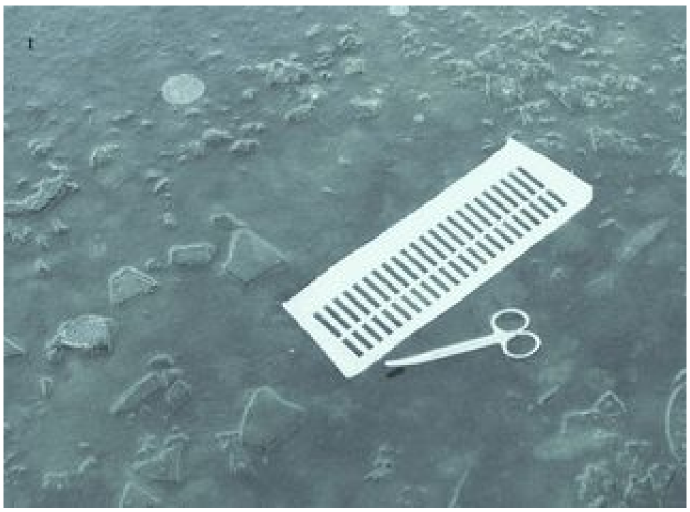
After 15 minutes, a hole cut into the ice of a river near Moscow is not frozen enough to support the weight of heavy iron scissors, which sink partially into the water.

In order to help prevent the melting of Arctic ice, a process that has been occurring at alarming rates in recent years, which many scientists believe is due gradual global warming, a group of researchers have proposed a partial solution that is quite novel: covering select small regions with a layer of a porous polymer that would reflect sunlight and promote freezing, thereby reducing melting.

When ice in the polar regions melts, dumping large quantities of unsalted water into the ocean, there are many negative consequences. For example, the extra water—a sea-level increase of about two millimeters per year—tends to bulge around the equator due to Earth's rotation, possibly stimulating tropical storms and making them more powerful and frequent.



An equal sized hole in the ice, this time with a polymer raft placed in it. Fifteen minutes later, the ice is thick enough to support the scissors&acute weight.

Another issue is the lack of ice that remains available to reflect sunlight, since ice is a far better reflector than water, turning away 70-90 percent of the Sun's rays compared to just 7-10 percent for water. This absorbed light heats the water, furthering the melting.

Additionally, large areas of the Arctic ice are unstable. In areas where super-chilled water mixes with ice pieces ranging from a few millimeters to a meter in size, the waves and currents of the water prevent the pieces from aggregating into larger ice platforms.

Tamara Tulaikova, a researcher at the Institute of Geophere Dynamics at the Russian Academy of Sciences, along with her colleagues, believe that covering some of these regions with sheets of a very thin, porous polymer material could help the ice pieces form larger icebergs.

She told *PhysOrg.com*, “It could be possible, under the right weather conditions with no wind, to distribute these polymer films by airplane. Each piece of film would be several meters in dimension. The polymer would help calm the local waters and have a better reflectivity than open water, and its tiny cavities would draw up water and provide sites for the ice to crystallize.”

In each polymer “raft,” as the group calls them, capillary forces would coax the water up into the cavities, which would each be about 150 micrometers (millionths of a meter) in diameter and about 0.2 meters in height. The water would then have a chance to freeze, providing the foundation for the growth of a large ice structure.

The rafts would also calm the choppy waters nearby and reflect more of the sun's rays than sea water.

“Each porous polymer raft would act like a floating refrigerator,” said Tulaikova.

She and her colleagues, including researchers from the Moscow Institute of Physics and Technology and The University of Aizu in Japan, tested the effectiveness of the rafts on a river near Moscow near the end of autumn on a sunny, windy day, with water and air temperatures of -1°C (30°F) -3°C (27°F), respectively.

They cut out two meter-sized holes in the ice, placed a polymer raft in one and left the other empty for comparison. After 15 minutes the ice near the raft was so thick that it could support heavy iron scissors, while the ice in the empty hole was still in the very beginning stages of formation.

The researchers also tested the rafts in salty water via several experiments on days of varying temperature and weather during the 2005/2006 Russian winter. Temperatures varied from -2°C to -30°C (-22°F). They noticed similar results as the river experiment.

The group says that composite rafts consisting of both porous and salt-repellent layers and an upper reflecting layer consisting of steel ribbing, originally developed for the water-purification industry, could be more suitable for ocean use.

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