ANTI-FOULING COATING MAKES HEAT EXCHANGERS MORE EFFECTIVE

Fouling is a common and a complex process in which materials of diverse origin – biological, organic and inorganic – adhere to surfaces that are in contact with liquid medium. Fouling appears in many industrial installations causing inefficient process output, reduced lifetime and thereby demands for frequent cleaning and/or part replacement, which leads to increased maintenance cost.

One such industrial installation that often is exposed to fouling is heat exchangers (found at power plants, ships or district heating plants e.g.), a piece of equipment built for efficient heat transfer from one liquid to another. Heat exchangers come in many different sizes from a few squared centimetres to several squared meters in plate area, and are employed in many vital industrial processes. Their malfunctioning could lead to serious safety and energy related problems. The current anti-fouling coating technology offers only thick coatings which results in poor heat transfer properties and is therefore not an optimal solution for eliminating fouling in heat exchangers. By developing a coating with antifouling properties, it would extend the time between the dismantling of the heat exchanger for cleaning or possibly avoid this completely. This would save a lot of time and hence money. The principle of a heat exchanger is shown on Figure 1.

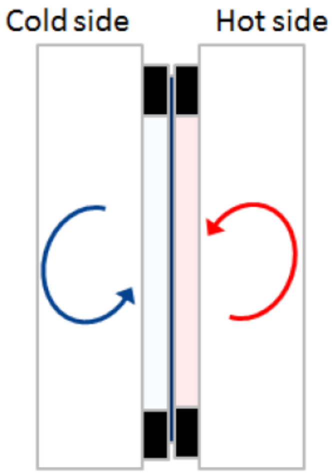

Figure 1: Principle of a heat exchanger. Heat travels from the hot side across stainless steel plate to the cold side

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Thin film with antifouling properties

This project takes a multi-disciplinary approach covering areas of polymer chemistry, surface chemistry, microbiology and nanotechnology to implement a novel anti-fouling coating technology platform for heat exchanger applications. The goal is to develop stable heat transfer effective anti-fouling coatings for heat exchanger installations. The coatings will be made on stainless steel since this material is used for fabrication of plate heat exchangers. The coating should also be sufficiently thin to allow for better heat transfer properties, since there is a less isolating layer on the stainless steel plates. To this end, we will employ a unique combination of surface modification tools to chemically attach different types of hydrophilic polymers and/or metal nanoparticles having a total thickness less than a micron (10-6 m). The attachment of hydrophilic polymer molecules is illustrated in Figure 2.

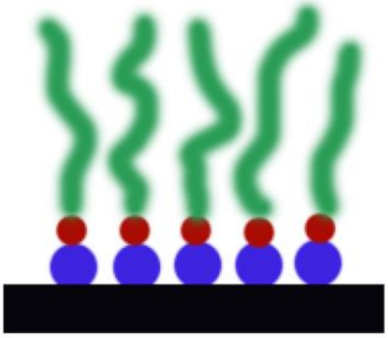

Figure 2: Illustration of the thin polymer film (green) on a stainless steel surface (black) bounded through an anchor molecule (blue) and an initiating molecule (red)

Several parameters will be studied systematically to optimize the coating performance in terms of thermal conductivity and resistance towards water solubility. It is important that the coating remains stable over time ensuring the antifouling properties remain constant for as long as possible. The thermal conductivity of the coated stainless steel plates should be similar to uncoated plates to ensure good thermal contact between the hot and cold side. A large number of scientific analytical techniques will be employed to investigate e.g. the molecular composition of the films on the plates and the amount of hydrophobicity.

The anti-fouling properties of the coated surfaces will be evaluated using different types of microscopy techniques equipped with a flow cell. The heat transfer efficiency will be tested by mimicking the relevant conditions employed at the chosen industrial site in a lab scale heat exchanger setup. Finally, the optimized coatings will be tested on commercial heat exchanger installations in collaboration with industrial partners.

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