REDUCTION OF MILK FOULING INSIDE PLATE HEAT EXCHNGER USING NANO-COATINGS

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ABSTRACT

Production problems arise through food processing as a result of residue formation on the wall of heat exchangers from the perspective of production time and cleaning procedure. The deposits should be completely removed by regular and intensive cleaning procedures in order to be in adequate with the hygiene and quality regulations for food industry. The deposits, which are normally formed through the thermal treatment of milk, decrease the heat transfer and increase the pressure drop in the heat exchangers.

Metal surfaces from stainless steel, as are often used in the food industry, tend to have high surface energies**.** The adhesion of product on metal surfaces is mainly determined by the surface energy and surface roughness. The adhesion of residues could be reduced by either decreasing the surface energy of the metal or by coating the surface with high anti-adhesion (low surface energy) layer like nano-coatings. The heat exchanger surface is coated with nano-coatings to avoid or minimize adhesion of deposits, simplify cleaning processes with lesser resources and chemical use, and increase the product reliability.

Heat exchanger facilities in the form of laboratory and pilot scales have been specially developed for the thermal treatment of milk. Laboratory facility was constructed by the Institute for environmental technologies IUV, University of Bremen, to test small stainless steel tubes coated with nano-technology. Practical tests with milk were carried out on a small plant by the Institute of Food Quality LUFA-Oldenburg, with the support of the company GEA Ecoflex. Four different coated plates were equipped in the heating section of a pasteurizer; furthermore PTFE coated plates, next to some electro-polished and stainless steel plates. The four different anti-fouling coatings were high-molecular polymers with implemented nano-particles which were promoted with high hardness and scratch resistance. The pasteurizer was operated with a 10% whey protein solution which was heated up to 85°C.

Coated heat exchanger plates with nano-technology

The results showed significant differences between coated and uncoated plates. Three coatings showed a reduced fouling behavior in comparison with the standard stainless steel plates. The electro-polished plates showed also a lower fouling behavior in comparison to the standard stainless steel plates and almost comparable to the coated plates. The cleaning in place (CIP) time was reduced by all coatings: PTFE coated plates down to 10%; coated plates down to 30%; electro polished plates down to 64%.