Institution: BRUNEL UNIVERSITY (H0113)

Unit of Assessment: 12 Aeronautical, Mechanical, Chemical and Manufacturing Engineering

Title of case study: Improving the performance of water meters

1. Summary of the impact (indicative maximum 100 words)

Research has led to improvements in the performance over 16 million water meters manufactured by Elster Metering Ltd. since 2008, extending their working lifetimes and reducing maintenance costs. In particular, research on polymeric replacements for the glass in water meters helped Elster establish their product development strategy, and led to changes in the manufactured meter. Brunel University research identifying a specific set of acetal polymers that reduce the degradation of the bodies in water meters has been incorporated in 1.8 million water meters. These meters have less embodied carbon dioxide, and are less prone to theft than the meter with brass components they replace. This innovation allowed Elster to reduce the costs of manufacturing in the UK, thereby maintaining a strong competitive position within the market for water meters.

2. Underpinning research (indicative maximum 500 words)

Elster Metering Ltd. is an international company specialising in advanced metering infrastructure, installing intelligent metering to the gas, electricity and water industries worldwide. Prof Tarverdi, Director of Extrusion Technology at Brunel University, was approached by Elster in 2003 to help identify the factors influencing the wear and fatigue in the moving parts in water meters, and develop new materials to improve installation life-time and reduce maintenance costs. Given his expertise in polymer processing, mechanical, thermodynamical, microscopic and elemental analysis, and in using extrusion and injection moulding technologies, Prof Tarverdi was asked by Elster to provide detailed information and advice about the composition of the compounds used in their water meters. This initial relationship with Elster has developed into a long-term collaborative partnership, and Prof Tarverdi's research has been continuously used since 2003 to enhance the properties of the materials for manufacturing and moulding Elster's water meters. During this time over 20 projects were commissioned and completed by the Brunel research team. See for instance [1].

In 2005, Elster wanted to replace some of the metal and glass components in their meters. To identify replacements for the glass, Prof Tarverdi examined the effects of using polycarbonate with 'nano-clay' [2]. This was found to prevent moisture ingression, thereby maximising the transparency of the polycarbonate moulding. This research successfully demonstrated the potential of the method [3,4].

In 2008/09, Prof Tarverdi further enhanced the compounds used in the manufacture of the water meters by identifying how potential long term corrosion in the bodies of the water meter could be prevented. His research involved exposing a range of polymers to the chemicals in the water and the intensive rays of the sun (ultra-violet oxidation) to determine their susceptibility. He identified a specific set of acetal polymers which demonstrated minimal chemical degradation. In addition, he provided guidelines for connecting the meters into the water network in the presence of copper and bronze pipes.

This research demonstrated that some chemicals, which are supposed to enhance the properties of polymers [5], were not performing to the required standard to prevent polymer deterioration and degradation. The compounds used to manufacture the Elster meters did not seem to have had the optimum masterbatch (concentrated compounds) to prevent UV oxidation and degradation of the meters.

This finding has led the Brunel University to successfully apply for the TSB call 'Boosting Innovation in Manufacturing Competencies'. The project, 'Ultrasonically Assisted Compounding for Masterbatch Production' [6], with industrial partners Colloids Ltd., Telsonic, Omya, Johnson Matthey and Elster, aims to enhance existing materbatch productions by using nano-fillers such as nano-carbon black, pigments and antioxidants through ultrasonication to achieve maximum dispersion of nano fillers. The new materbatch, once verified for its effectiveness, will be supplied to companies like Elster to manufacture their components and assess its effectiveness.

3. References to the research (indicative maximum of six references)

1) K. Tarverdi, "Establishing the failure characteristics of small pistons", Elster Metering Technical Report 2005. Available from Brunel.

2) K. Tarverdi and S. Sontikaew, "Experimental study of extrusion and surface treatment of organo clay with PET nano-composites", Annual Technical Conference, Society of Plastic Engineers, ANTEC 2008 Milwaukee May 4-10, p 1387-1391.

   http://bura.brunel.ac.uk/handle/2438/7665

3) S. Sontikaew, "PET/Organoclay nano-composites", PhD Thesis, Brunel University 2008, http://bura.brunel.ac.uk/handle/2438/3280.

4) K. Tarverdi, "Experimental study of extrusion and surface treatment of organo clay with PET nano-composites", Polymer Process Engineering 2009, Enhanced Polymer Processing, IRC polymer engineering - University of Bradford, p 160-172 ISBN: 13-978-1-85143-262-2.

5) K. Tarverdi, "Chemical Attack – Acetal/Zinc Cloride and Creep Test Programme", Elster Metering Technical Report 2008. Available from Brunel.

6) Technology Strategy Board grant number 101272, August 2013, £981,000.

4. Details of the impact (indicative maximum 750 words)

Elster Metering have been producing rotating piston meters incorporating compounds developed with Professor Tarverdi's support since 2003. During this time approximately 32 million meters have been produced incorporating these results that have an excellent track record of successful operation. Of these 16 million were produced since 2008.

Elster report that the research supporting the replacement of a hermetically sealed glass lens with a polymer version has been very useful in establishing a long term vision for their product development. In particular, meters incorporating this feature are now being manufactured in the Far East and Elster are currently considering incorporating this feature into meters manufactured in the UK.

The research identifying the acetal polymer as a factor in the reduction of degradation in the bodies of water meters has had a significant impact. Elster used the results to decide to accelerate the brass to polymer change-out program and to revise the compound choice for meters manufactured for use in Europe and the Middle East. The research was also used to revise the network application guidelines for their customer's installers. Elster report that Brunel research enabled them to "maintain a strongly competitive position from our UK manufacturing base based on lower costs, reduced embodied CO_2 and reduced theft risks compared with the equivalent brass meter".

The findings from this research were incorporated in the wide scale roll out of polymer water meter bodies in a range of demanding applications, including approximately 1.2 million units in the UK, 500 thousand in northern Europe and 100 thousand in the Middle East. In the Middle East, the problem of degradation is much more acute, and therefore the benefits of this development are much more significant.

5. Sources to corroborate the impact (indicative maximum of 10 references)

The Head of Design of Business Unit Water at Elster Metering can be contacted for the research impact and the sale information of Elster meters.