Rapid Prototyping Solution for the Production of Vulcanized Rubber Components

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Abstract. Additive manufacturing technologies are quickly becoming more accessible and are being integrated in the workflow of the manufacturing industry. These technologies are often used for prototyping in the product design process. However the fact that there is a limited choice of printing materials means that prototypes of rubber components can rarely be printed from the desired material as used for real production. This paper investigates the possibility of producing prototypes of vulcanised rubber components by injection moulding process using 3D-printed Polyether Ether Ketone [PEEK] inserts. This would allow the production of a batch of rubber parts without needing to produce a metal mould, which is both costly and time consuming.

3D printing a mould insert presents a great challenge, since unlike thermoplastic polymers the mould for rubber materials is heated in order to vulcanize the material. PEEK was chosen as the 3D printing material, as it is capable of withstanding the moulding temperatures involved in rubber production. The process of 3D printing using Fused Deposition Modelling [FDM] and three different PEEK grades was investigated in great detail. Three printing parameters, namely temperatures, infill percentage and annealing, were varied to produce mould inserts. Mechanical and thermal properties of the printed inserts were then tested. The optimal PEEK grade and the printing parameters were then used to produce the final mould insert, which was then used for the injection moulding of the rubber components in real industrial conditions. The current experiments show promising results since the moulded samples of the rubber components was successfully produced before the PEEK insert started degrading. By compensating the parameters during the injection moulding and the post-curing, the resultant samples showed similar mechanical properties as other counterparts moulded using a conventional metal mould.