A New Pair of Hard-soft Plastic Combination for Precision Manufacturing of Two Component Plastic Parts

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Abstract

Two component (2k) injection moulding is growing rapidly even in the field of precision micro moulding. Besides combining different material properties in the same product, two component moulding can eliminate many assembly steps in manufacturing process chain. One of the biggest technical challenges associated with 2k moulding is the unavailability of suitable material combinations which can meet the diverse requirements both from product and process point of view. This paper presents a new pair of commercial polymer materials (BASF Ultramid A3EG10 and Kraiburg TPE Thermolast K TC5PCZ) that fulfils the criteria for 2k moulding both from product and process considerations. Ultramid A3EG10 is PA6.6 thermoplastic with 50 % glass fibre reinforcement. Thermolast K TC5PCZ is a thermoplastic elastomer based on hydrated styrene block copolymers (TPE-S). By using this pair of materials, a demonstrator 2k micro part (Socket house for hearing aid) has been fabricated by the use of state-of-the-art 2k micro moulding machine. The tests performed on the demonstrator showed potential for the material pair to be used in high precision two component moulding applications. All the test procedures and results presented in this paper can be a valuable source of information for researchers and scientists who work with two component micro injection moulding.

1 Introduction

Two component injection moulding is a unique process technique that combines two different plastic materials in the same product. The development in 2k technology has been great in last couple of years. Nevertheless, the technology still faces many challenges when it comes to the point of precision 2k micro moulding. This paper carries out experimental investigation to prove the feasibility of using a 2k moulded sealing ring for highly precise hearing aid application. It also tests the feasibility of using newly developed micro 2k moulding machine in highly demanding application areas like hearing aid technologies.

1.1 Demonstrator Product

Chosen demonstrator product for this investigation is a RIC (Receiver-in-canal) socket for hearing aid application. The RIC hearing aid system uses a Plug and a Socket to connect the hearing aid receiver with the rest of the hearing aid body via a thin wire (see Fig 1). The problem with the current Plug-Socket combination is the clearance between the plug-socket that allows moisture, sweat, oil, dust and other corrosive agents to get inside the socket house; those corrode the contact pins and in the long run the system loose electrical contact. To overcome this problem a new Socket is designed (presented in Fig 1) with an incorporated sealing ring that can ensure sufficient sealing between the Plug and Socket to protect inner metallic components inside the Plug and Socket house.

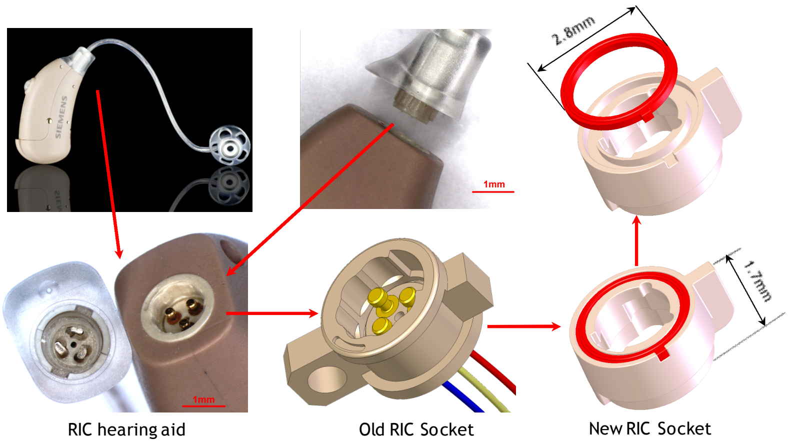

Fig1: Schematic representation of RIC hearing aid, RIC connection (Plug-Socket combination), Old design of RIC Socket and new design of RIC Socket.

2 Experimental Investigation

The objective of this experiment was to test the feasibility of using a moulded sealing ring with the hearing aid RIC Socket to protect the inner metallica components.

2.1 Materials, methods and equipment

Many possible combinations of plastic materials were applied in the investigations. But the current paper contains only discussions based on the two most successful materials: Polyamide 6.6 with 50% glass fibre (BASF Ultramid A3EG10) and Thermolast K (TPE-S from Kraiburg TPE, Germany). The test geometry for this experiment was the new design of 2k Socket house presented in Fig 1. For the bond test between two plastic materials the Tensile Bar was used. For moulding 2k parts, Formica Plast 2k micro machine from Klöckner DESMA was used. To test the bonding between two materials a tensile testing machine was used and to test the sealing of the sealing ring, new test equipment was developed (shown in figure 2). The sealing test device could provide hydraulic pressure inside the socket house and precisely detect the pressure developed inside the socket house and finally could detect the leak of the fluid over the sealing ring.

2.1 Results and discussion

The Socket was successfully moulded with PA (for Socket house) and Thermolast (for sealing ring) by the selected micro 2k machine. There was little problem with the flash due to the faulty mould, otherwise moulding was quite successful. Some of the plastic materials like PEEK were hard to mould with DESMA machine but PA worked fine. Replication quality of the 2k parts was investigated by visual and microscopic investigation. The adhesion of the two plastic materials was characterized by tensile testing both for sequential and simultaneous injection of two materials. The tensile test showed that the bond between the PA and Thermolast was acceptable both in case of simultaneous moulding and sequential moulding (about 2.1 and 3.2 MPa respectively-see Fig 2). The sealing test showed that in most cases the sealing ring could withstand at least 2 bar of gauge pressure which was quite acceptable for the hearing aid application.

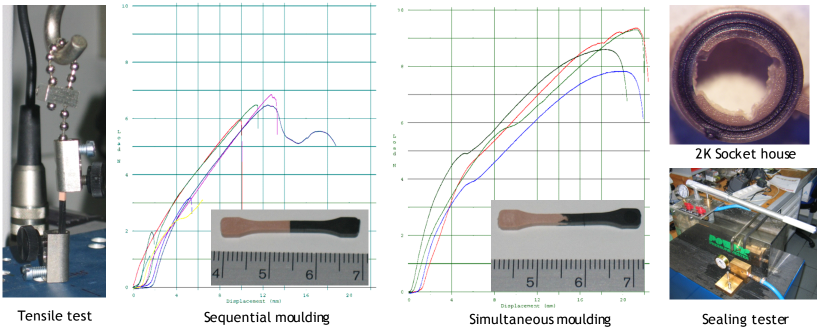

Fig 2: Tensile test performed on 2K tensile bar and sealing test performed on 2K moulded Socket house.

3 Conclusion

The investigation conducted with this paper showed the potential of moulded sealing ring for RIC applications. The selected materials were suitable for 2k micro injection moulding and the parts were successfully produced by the use of 2k micro injection moulding machine. The characterization showed the produced 2k parts could meet the technical requirement imposed on them by high end engineering applications like in hearing aids.

Acknowledgement

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