Economic production of anti-skid sole inserts

PU-soles

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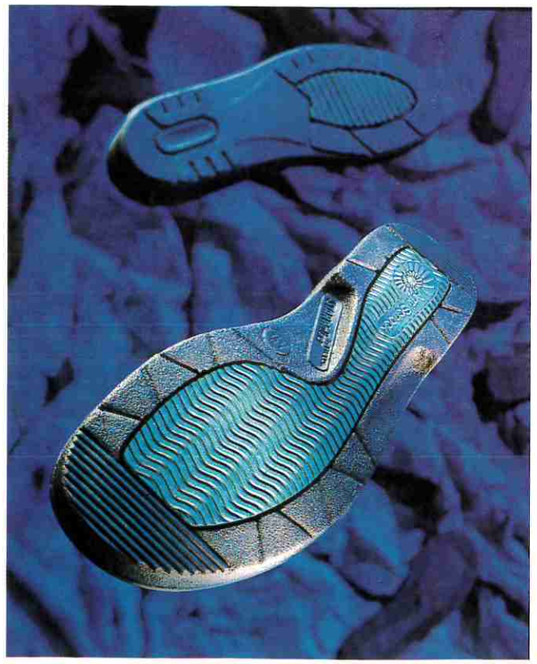
In order to obtain outsoles which are both skid resistant and light, producers have so far manufactured polyurethane (PU) soles with an insert made of rubber, TPU or similar material. The problem with this process was the separate production of sole and insert: Since PU processors in general do not have the necessary equipment available for the manufacture of rubber or TPU, they had to sub-contract the inserts, often at high prices.

In response to this problem, Elastogran GmbH and Messrs. Winterberg of Hauenstein have developed a material and the necessary process technology to manufacture anti-skid outsoles. These are made entirely in PU, with the advantage that the inserts can likewise be manufactured using conventional PU processing equipment.

Conventional problems

Hithero, a large sheet mould had to be fabricated for the manufacture of rubber inserts. These sheets were punched out to the appropriate sizes which were then transported, sorted, cleaned, possibly activated and, in most cases, coated with an adhesive.



Pict.: Outsoles with PUR-inserts

To achieve perfect adhesion, a dust-free and clean working environment was absolutely essential.
The same applies to the use of TPU. Besides higher material costs, another factor is the more complex nature of the moulds.
Because of the high material and processing costs, there remained little room for manoeuvre in design as, in order to amortise the costs, the inserts had to be made in large numbers. While processing rubber elements required a single mould and different punching tools, the use of TPU often required a complete set of moulds to obtain an acceptable finish.

Rationalisation

The main aims were to avoid manufacture of anti-skid outsole inserts and light PU substrate parts at different times and places, to minimise mould costs and facilitate design variations. A conventional F-20 peripheral low-pressure Elastogran plant was available for use at the Messrs. Winterberg factory. This was converted to the new requirements and the existing set of moulds was adapted to the new process.

System description

The supporting outsole is made using a conventional Elastopan S 7010 or S 7015 series polyether polyurethane system (for physical values see fig. 1). The anti-skid surface is produced either as a continuous sole or as separate pieces for the heel and ball region and cast in S 7010/15 compact polyether polyurethane, recently developed by Elastogran. Since S 7010/15 is based on the same

	Dim.	Elastopan S 7010/12 (Comfort Sole)
Density	kg/m³	550
Hardness	Shore A	63
Tensile strength	N/mm²	4.7
Elongation	%	435
Tear propagation Resistance	N/mm	8.3
Abrasion DIN	mg	165
Special abrasion	mm	190
Repeated flexural Behaviour	Bending o.k.	100,000
Anti-skid property*	Degree	27

* Dr. Funck Machine/Steel plate/dry

Table 1: Mechanical properties (comfort sole)

	Dim.	Elastopan S 7010/15 (Compact Sole)
Density	kg/m³	1000
Hardness	Shore A	46
Tensile strength	N/mm²	4.8
Elongation	%	625
Tear propagation Resistance	N/mm	5.6
Abrasion DIN	mg	224
Special abrasion	mm	160
Repeated flexural Behaviour	Bending o.k.	100,000
Anti-skid property*	Degree	40

* Dr. Funck Machine/Steel plate/dry

Table 2: Mechanical properties (compact sole)

isocyanate component as the system for the supporting outsole, only three components – two polyol and one isocyanate – are required. Wear trials have confirmed the excellent anti-skid properties as well as excellent adhesion of the two layers and a high resistance to mechanical stress (for physical values please refer to fig. 2). The antiskid properties are maintained at temperatures below 0°C.

Process description

The compact anti-skid surface can be produced in a separate operation in an individual mould, and subsequently inserted into the outsole mould. However, it is also possible to cast the material directly into the mould for foaming. In this instance the compact material is cast without a mould lid. This provides excellent adhesion for both layers since neither of the two surfaces comes into contact with a release agent, providing short production cycles for the complete sole and hence cost savings. In order to optimise this application, it is necessary to coordinate the manufacturing process and the plant technology.

Advantages

A prime advantage is that the method extends the range of design options for anti-skid outsoles. For example, a shoe may have either the outsole and substrate in the same colour, or incorporating a second different coloured surface (see illustration), with the consequence that this technology is not exposed to the whims of fashion. The extremely soft anti-skid outsole is combined with the supporting PU part in an optimum manner, giving a comfortable feel when walking. This opens up a lot of possibilities, especially in the orthopaedic sector.

The authors

Bernadette Sandmeyer (born 1955) has been managing director and co-owner of Messrs. Winterberg since 1995. She took over commercial management of the company in 1978 and the technical management in 1988. In 1991 she supervised the establishment of a new production unit in Poland.
After studying applications mechanical engineering, Klaus Pittrich (born 1948) joined the technical department in Elastogran GmbH at Olching, Germany, where he was responsible for the export market. After a period as technical manager for Elastogran France, he became head of purchasing. Since 1993, he has been responsible for the company's shoe development and application technology.