13.1 INTRODUCTION

This study is concerned with the development of polyurethane foam shoe soles, by Clarks. It is an example of intuitive design skill allied to technical development of a high order. The will to succeed was perhaps the most important factor of all. The study also provides an excellent example of a polyurethane application, with a comparison with competitive types of material. In the development described here market forces are particularly dominant.

13.2 SHOE MANUFACTURE - HISTORICAL

Traditional soling materials are supplied in sheets, e.g. leather, resin-rubbers, crepe and vulcanized rubbers, EVA, microcellular rubber. The sole shapes have to be cut from the sheet and then fastened to the upper. Such processes are labour-intensive, and wasteful of material, because of offcuts, but they allow changes of shape easily, as fashions change, and they are suitable for welt construction of shoes.

Welt construction shoes are the traditional design, with the uppers stitched to the welted inner sole, and the outer sole sewn to the inner (Fig. 13.1).

Variations of this traditional construction include the adhesive bonding of various parts, in place of sewing, e.g. in the 'veldt construction', in which the upper is turned outwards instead of inwards (Fig. 13.2). This allows an appearance similar to a welted shoe, but at a much lower manufacturing cost.
Polyurethane shoe soles

The advantages of sheet materials are essentially those of flexibility of design. Fashion changes are quickly and easily accommodated, and it is easy to supply a large number of size variations, e.g. several widths per size number.

The disadvantages are the labour-intensive nature of the work, and slow production rate, which lead to high cost. Also, the processes are wasteful of material, because of the offcuts. There is an inherent design problem because the flat-sheet material has to be distorted to form the shoe; the result is that in the shoe, the soling material is in tension, and this can lead to premature failure in some materials.

The first important departures from traditional manufacturing methods involved the production of moulded shoes, and the use of adhesives to bond uppers directly to soles: adhesive bonding was applied variously to moulded soles and those cut from sheet material. By the 1950s, the majority of shoes were manufactured with adhesive (Fig. 13.3).

Considerable improvements in production costs and output were achieved. For the customer, there was the advantage of reduced cost, and an improvement in waterproofing.

The shoe manufacturing industry was now fully into the era of technological development which characterized the 1950s and 1960s. The hold of traditional methods of manufacture had been broken, and the climate was right for the exploitation of the new materials and techniques that were in their most rapid phase of evolution. The driving force was economic; labour and material costs were increasing, and there was every incentive to perfect new manufacturing methods and to exploit emerging new synthetic materials. One of the most important of these was to emerge from Clarks. It was the direct vulcanizing technique, in which rubber soles were attached to the lasted shoe upper and the rubber vulcanized in a single moulding operation. This process gave shoes which were very durable, and at the same time eliminated separate vulcanization of the sole compound. An adhesive is applied to the upper before moulding, but none is needed on the sole. Separate engineering and rubber factories were established to exploit the process, in the body of the Larkhill Rubber