NPL
National Physical Laboratory

British companies overcome manufacturing challenges to launch and scale-up of a new generation of orthotic insoles

Through Innovate UK's Analysis for Innovators (A4I) programme, two innovative small British businesses were able to engage the National Physical Laboratory (NPL) to help them deliver two new products successfully to market that are now generating rising revenues for them both.

Merlin Polyurethanes has been manufacturing polyurethane moldings for more than 25 years, working mainly for British car producers. In 2018 it was approached by Enertor – a small business specialising in the manufacture of bespoke orthotics. Enertor's proposition was to jointly develop a new generation of insoles for the mass sport and recreation market. Enertor, with more than 25 years specialist knowledge of podiatry and the impacts which footwear and orthotics can have on general human health, reducing pain and preventing injuries, provided the initial concept. Merlin Polyurethanes had all the necessary facilities, the production capacity, the expertise and the will to support the initial technical development of the insoles, as well as their manufacture at the forecast volume.

Two new types of insoles had been developed and launched as planned in May 2020 and despite the upheaval of the pandemic, positive customer reviews on major websites and in significant consumer publications started coming through within just nine months.

But when production began ramping up to meet increasing demand, a challenge emerged.

One of the Enertor products manufactured by Merlin Polyurethanes.

Challenge

It became apparent that the hardness of the products measured at Merlin and at Enertor was inconsistent. Testing results varied significantly between the two companies as well as between individual operators, indicating potential issues with either the manufacturing process, the testing process, the testing equipment, or all three.

The issue culminated in Enertor rejecting several batches of the new insoles due to their substandard quality. This shook both companies' confidence in their ability to rapidly scale up production and cast doubt on the feasibility of the entire venture. It resulted in a lot of product waste and lost money, and it affected the trust that existed between the two companies.

After numerous checks and comparisons both Merlin and Enertor realised that the standard method of assessing industry hardness using off-the-shelf durometers was not suitable for these new products. Tests using this approach showed a huge variation of +/- 10 units, while the acceptable specification range was +/-2.5 units. To control the manufacturing process and provide Enertor with consistent quality, a more suitable hardness testing method was needed.

Merlin Polyurethanes decided to apply to Innovate UK for access to expertise and equipment at NPL through the A4I programme.

Solution

NPL conducted a thorough evaluation of the equipment used to test Enertor's insoles, taking precise measurements at every stage of the process. It looked carefully at the multitude of variables that could have impacted the accuracy and effectiveness of the test. NPL's highly controlled environments and its advanced equipment allowed the team to remove any relevant variables and find the best QA test solution. The team's access to Instron systems and its ability to harness their capabilities were particularly relevant. Instron makes measurement systems that are specifically designed for highly accurate materials testing. In this case, were used to create a compressive load displacement test that could how much the insoles changed shape when pressed with a certain force with an accuracy Merlin had not previously been able to deliver.

Following the research and recommendation of the NPL scientists, Merlin Polyurethanes designed and built totally original hardness measuring devices specifically for the new Enertor products that accounted for their unique softness, lightweight density, and slim design. The three devices were benchmarked against each other, and their accuracy and consistency were validated in by both companies. The accuracy of the applied hardness measurement went from an initial spread of +/-10 units to +/- 1 unit and the new testing method proved to be consistent, repeatable and reliable.

"After being deeply concerned by the inaccuracy of the standard industry hardness measuring tests we had used, I was quickly amazed by the improvement we achieved thanks to this project with NPL," explains Steve Hurst, Merlin's Owner and Managing Director.

Impact

The project delivered a wide variety of positive effects on Merlin Polyurethanes and its client, Enertor.

Merlin Polyurethanes had enough confidence to restart production and Enertor to resume its orders. Manufacturing capacity was swiftly ramped up, and then scaled up to fulfill the growing demand.

Investment in further machinery and equipment to increase output became financially justified and production waste was dramatically reduced from approximately 20% to less than 2%.

Production capacity went from 20,000 units in 2020 to over 100,000 within two months of completing the A4I project. The growing orders from Enertor became a significant percentage of Merlin's turnover and made the company more diverse and less dependent on the volatile post-pandemic automotive market.

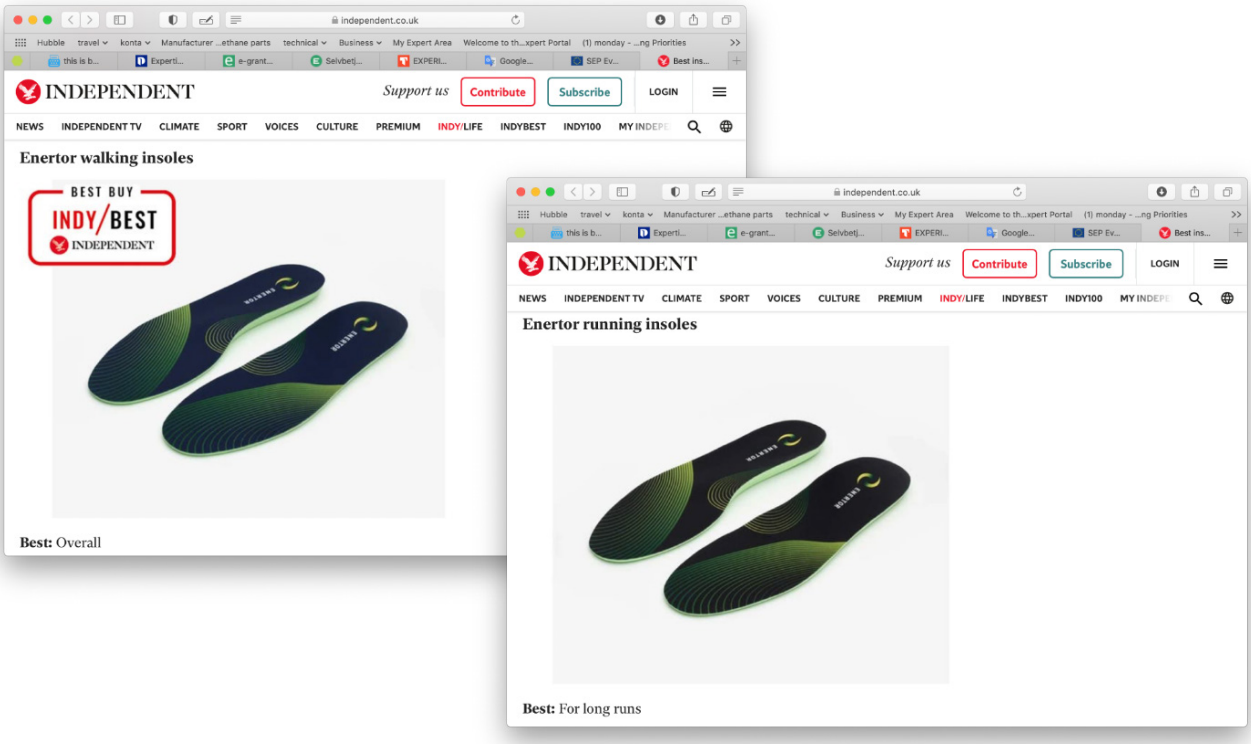
The change in results was significant enough for Merlin Polyurethanes to subsequently regain Enertor's trust. This quickly led to both companies signing a 5-year contract for exclusive cooperation.

"I can not thank Innovate UK and NPL enough for their work, which has made a tremendous difference to Merlin's turnover and business continuity" says Hurst.

"This is a perfect example of how a relatively small A4I project helped two SMEs working together to achieve success for each other's benefit." - says Enertor's Technical Director Dr Grazyna Mitchener.

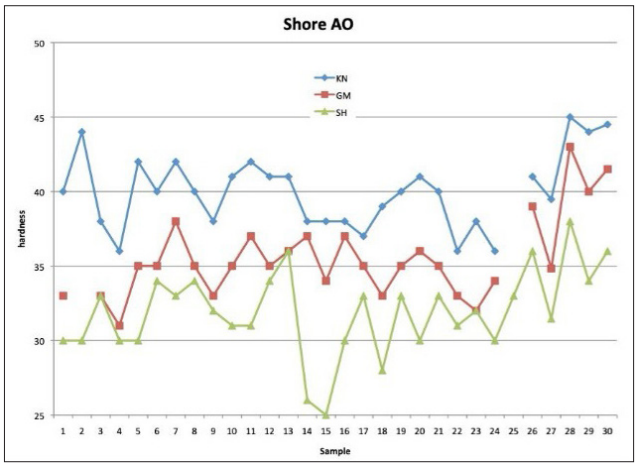
"Without the support of NPL's extraordinary expertise and its world class facilities we would not have been able to resolve the problems affecting both companies so quickly and so efficiently. The new approach to hardness testing has saved us both lot of time and massively accelerated our market expansion into Denmark, Germany, Italy, South Korea, Hong Kong and USA.

Working with Merlin Polyurethanes was critical for us as it is the only company able to manufacture our products in the UK, where we wanted our insoles to be made. The quality of the products supplied by Merlin Polyurethanes is now world-class. This is what we hear from our customers as well as from independent reviews in consumer magazines and on-line publications. We are looking forward to working with them on expanding the product range and the size of our product portfolio."



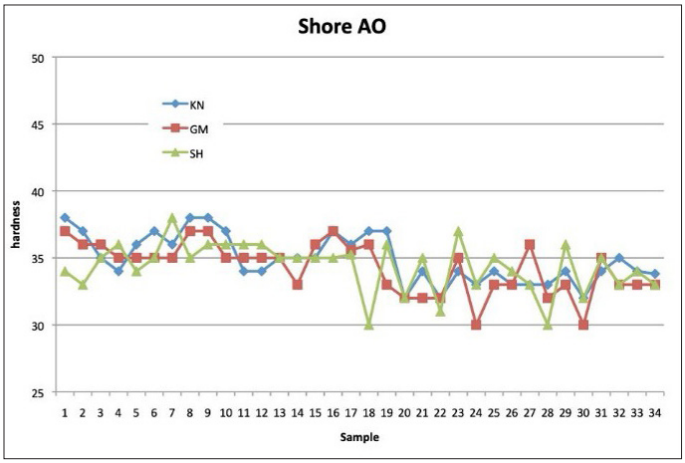
The first independent reviews of the products (2021).

Before



avg. difference **23**%

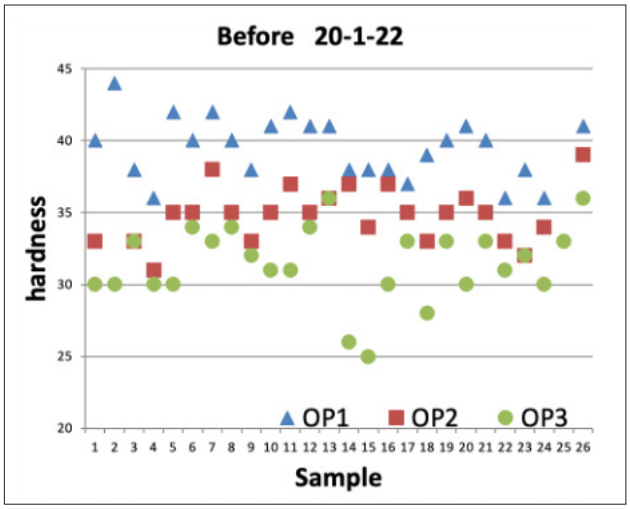
After

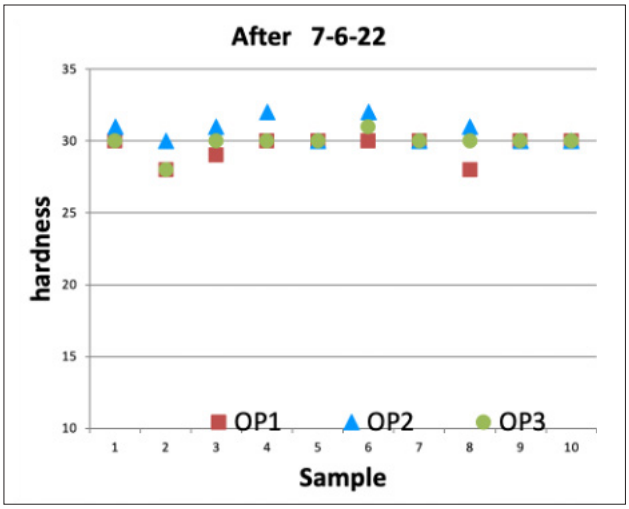


avg. difference **1.4**%

Results of testing by 3 different operators of the same batch of products before and at the end of the project.

Final results





Results of testing by 3 different operators of the same batch of products before and 2 months after the end of the project.

National Physical Laboratory, Hampton Road, Teddington, Middlesex, TW11 0LW
Tel: **020 8977 3222** | Web: **www.npl.co.uk**