RISE TO THE CHALLENGE: STOLL & NOTTINGHAM TRENT UNIVERSITY

Researchers from Nottingham Trent University (NTU) have teamed up with knitting machine manufacturer Stoll to help athletes tackle cold winter weather.

More than just hot air

A smart balaclava which warms oxygen before it is inhaled could help athletes to reduce the risk of contracting chest infections when exercising in cold conditions. It is the result of a collaboration between the Advance Textile Research Group (ATRG) at Nottingham Trent University in the UK and German advanced knitting machine manufacturer Stoll. Established in 2010, the ATRG has built a strong reputation for its research into wearable technology; one of its key areas of focus is the integration of electronic components into yarns and textiles. The group's leader, Professor Tilak Dias, has developed a pioneering technique to connect semi-conductor chips to fine copper wires, which can then be embedded within the fibres of a yarn. To puts its theories into practice, the group turned to Stoll and its innovative flat knitting machinery. Together, they created a prototype balaclava for runners and skiers who train or compete in winter weather.

The fully knitted garment features a patch of electric-conductive copper yarn over the nose and mouth. It emits heat when charged with an electrical current, which comes from a power socket located at the back of the balaclava. Plus and minus poles allow a rechargeable battery to be connected to it. When the battery is inserted, steady power passes along the conductive wires and warms up the area around the nose and mouth. "By using electric-conductive yarns, which are so tiny that they cannot be felt by human skin, we are able to provide a consistent level of warmth to a piece of clothing so that a runner only breathes in warm air," explains

The key to the balaclava's heating effect is a patch of conductive yarn over the nose and mouth.

Stoll

Stoll experimented with NFC technology when creating a pair of running tights and an accompanying arm cuff (right). The cuff also has an integrated opening for a smartwatch (left).

Stoll

Professor Dias. Electricity cannot be felt by the wearer as the current is so low, the researchers insist. They say the material used in the balaclava is fully washable and behaves like any other fabric. Reflective strips have also been incorporated to give increased visibility in the dark and four-way stretch offers a better fit and increased comfort.

World of possibilities

The project gave Stoll the opportunity to demonstrate the potential of its ADF range of flat knitting machinery (ADF stands for Autarkic Direct Feed, with the word Autarkic coming from a German word meaning independent or self-sufficient, in reference to the individually controlled yarn feeders). It allowed fully automated 3D pre-shaping of the balaclava, significantly reducing waste, which it is estimated was as little as 1%. "Pre-shaping contributes to fitting comfort as it follows the body contours without creating compression," points out Joerg Hartmann, Head of Fashion & Technology at Stoll.

Stoll says its ADF technology "has opened up a whole new world of possibilities in performance knitwear". Flat knitting allows the heating wires to be knitted directly into the fabric. "We can process different yarns with different properties and place them where they are needed," Mr Hartmann explains. Professor Dias believes modern flat knitting technology provides "an excellent platform" for the research and development of complex, 3D-shaped knitted garments due to its computer-controlled needle selection, needle bed racking and yarn carrier selection.

The balaclava is part of Stoll's Performance+ collection, a series of products made using its ADF machinery. It also includes a pair of running tights with an integrated pocket in the waistband for a smartphone. An NFC (near-field communication) chip knitted into the accompanying arm cuff can be used to activate a strobe light application on the smartphone, making the wearer visible when exercising at night.

Fine idea

Stoll's smart balaclava received an Outdoor Industry Award at the OutDoor show in Friedrichshafen, in 2016. It collected a Gold Award having been rated outstanding in several categories - degree of innovation, functionality, design, choice of materials, and workmanship. "This really is an innovation," the awards jury said. "The seamless construction is great; when we tried it on, the balaclava is really comfortable and the heating system around the mouth is a fine idea."

Mr Hartmann told *WSA* that Stoll is not planning to develop any more garments with integrated electronic components until it has gauged the market response to its first attempt. Nevertheless, he says early signs suggest there is plenty of interest, with some larger companies already exploring how to bring the concept to fruition. He also revealed that the company is working on a range of athleisure samples, which he expects will be unveiled in April. "I personally believe that flat knitting with our ADF technology provides a plethora of opportunities to companies in the sportswear industry," he adds, estimating that only around 20% of brands currently understand its potential.

For his part, Professor Dias emphasises the importance of collaborative research between organisations such as the ATRG and innovative companies such as Stoll. He describes the balaclava as "the tip of the iceberg" of what can be achieved in smart textiles if different industry participants work together.