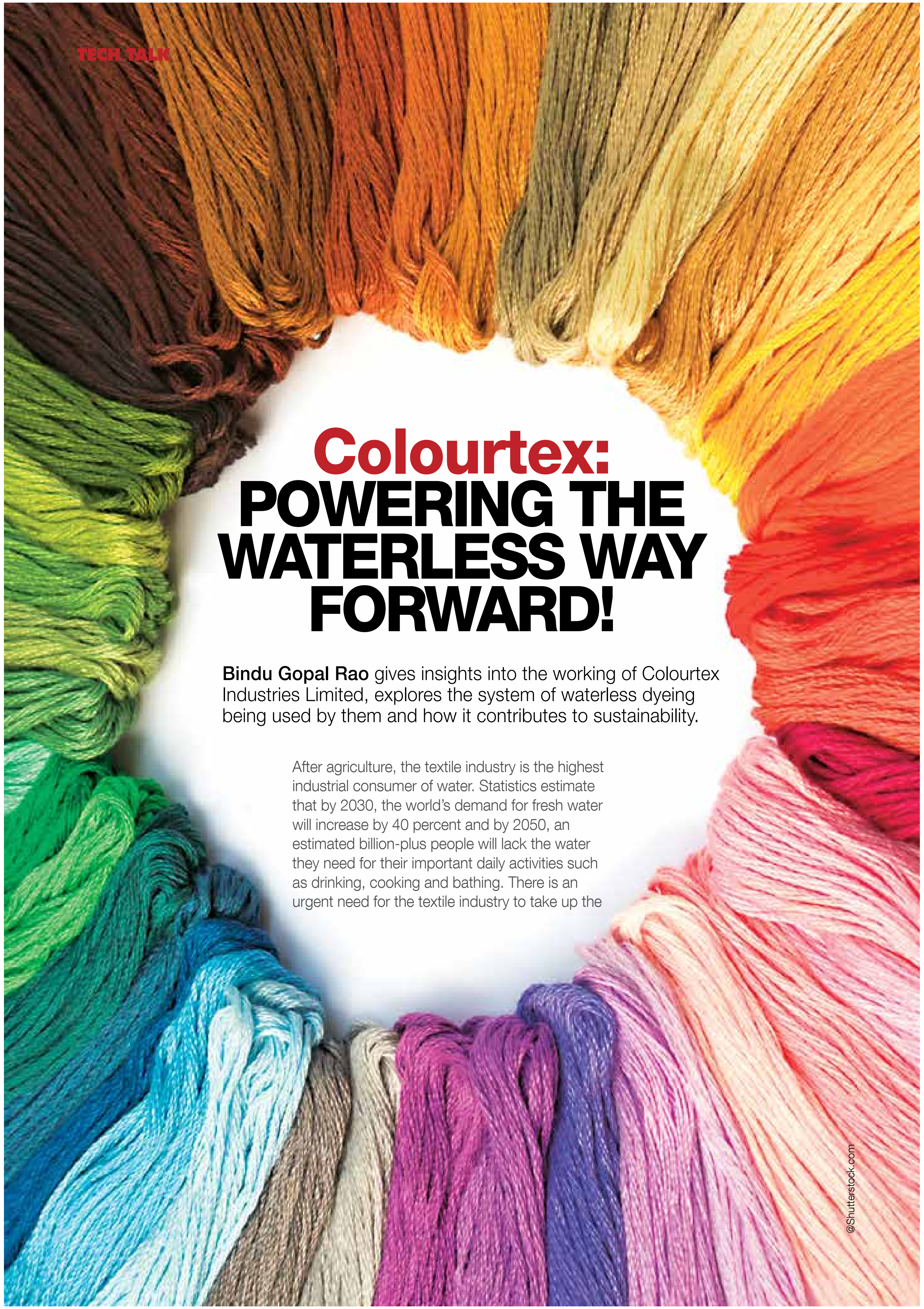

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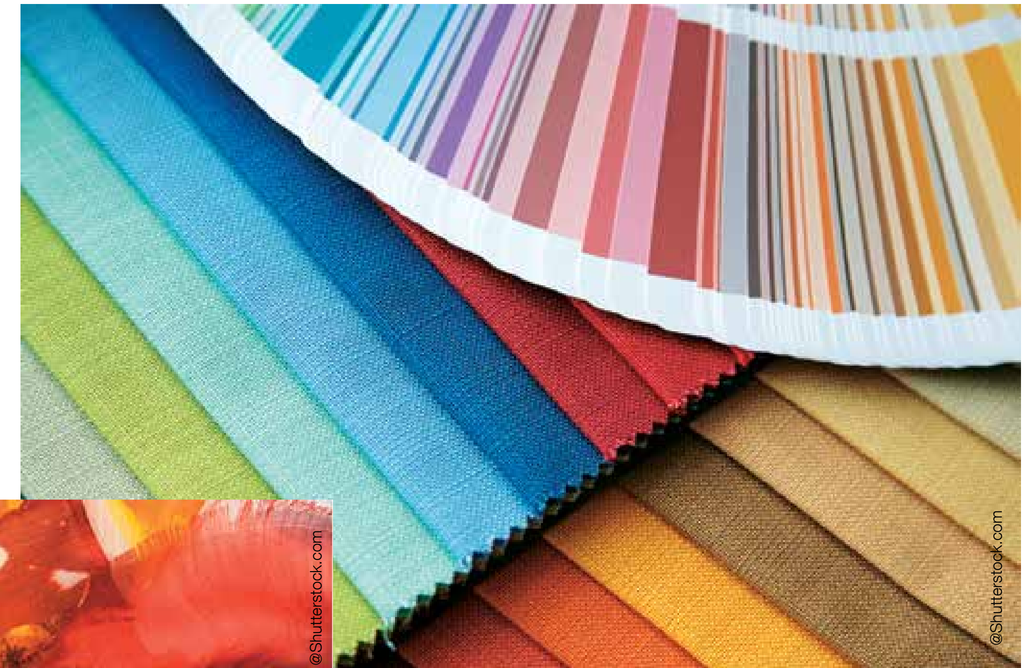
Colourtex: POWERING THE WATERLESS WAY FORWARD!

Bindu Gopal Rao gives insights into the working of Colourtex Industries Limited, explores the system of waterless dyeing being used by them and how it contributes to sustainability.

After agriculture, the textile industry is the highest industrial consumer of water. Statistics estimate that by 2030, the world's demand for fresh water will increase by 40 percent and by 2050, an estimated billion-plus people will lack the water they need for their important daily activities such as drinking, cooking and bathing. There is an urgent need for the textile industry to take up the responsibility and adopt sustainable business practices to truly reduce the environmental impact. And removing the usage of water from the dyeing process seems to be that solution. Water is a resource whose importance can hardly be over emphasised. Consequently, there is a lot of attention on conserving water resources, and the apparel industry is not far behind when it comes to conserving water. The textile industry, typically, has high water and energy consumption. However, today, new age technologies are being employed to ensure that the manufacturing processes control the input of water and optimise the chemical usage. This is a technology that does not use water or chemicals. So, what exactly does this technology include? Read on to learn more.

TECH TALK



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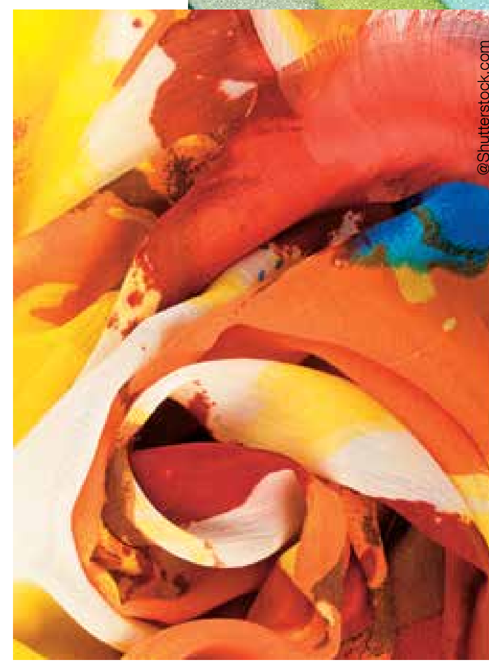

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THERE IS A LOT OF ATTENTION ON CONSERVING WATER RESOURCES, AND THE APPAREL INDUSTRY IS NOT FAR BEHIND WHEN IT COMES TO CONSERVING WATER.

NEW VISTAS

The increasing demand for novel colouration technologies, waterless dyeing and recycling dyeing methods is being seen, in particular, waterless dyeing concepts such as the dyeing of polyester fibres from supercritical carbon dioxide (sc-CO2) are of major interest. Supercritical fluids such as sc-CO2 are already established in the extraction of natural ingredients for food, pharmaceuticals or cosmetics and, are today, being used in the apparel industry as well. By using carbon dioxide as the application medium, this technology completely eliminates the use of water in the textile dyeing process and the sc-CO2 gas rather than water is used to infuse the fabric with colour. Dyeing with sc-CO2, Digital Printing, Plasma Dyeing, Transfer Printing and Foam Dyeing are gaining ground. Likewise, supercritical fluids (SCF) do away with toxic components, use fresh water and large waste streams. Dr Pankaj Desai, Head, Research & Development, at Colourtex Industries Limited, explains, "Polyester can also be dyed in a

TECH TALK

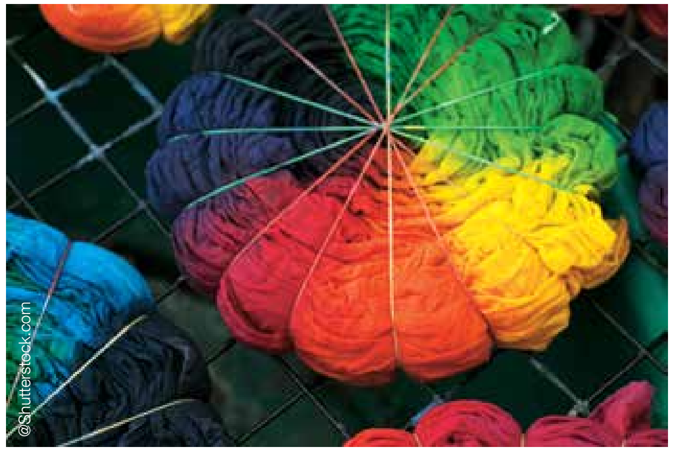
supercritical carbon dioxide bath with Corangar dyes specially developed for the SCF process. Corangar dyes are soluble in supercritical CO2 fluid. SCF swells the polyester fibre, allowing the dissolved Corangar dyes to diffuse through to the core of fibre. Lower viscosity of the supercritical CO2 makes the dye bath circulation easier and less energy intensive. Dyeing and removing excess dye are processes that are done in the same vessel. Residual dye is minimal (<one per cent) and may be extracted and recycled. SCF dyeing gives excellent levelness and shade reproduction, without affecting the physical properties of the polyester fibre."

TECH SPEAK

Supercritical fluids such as CO2 are highly compressed gases with both liquid and gas properties and sc-CO2 acts as both, a solvent and a solute, as it has higher diffusion coefficients and lower viscosities than liquids. This means that it has minimal surface tension which allows for better penetration into materials. "Supercritical fluid, a highly compressed CO2 gas, is non reactive at an extremely high temperature (120°C) and pressure (250 Bar), making it ideally suited for textile processing applications. Supercritical CO2 acts as both; a solvent (of Corangar dyes) and a solute (for the fibre), making it ideal for the polyester dyeing process, without using additives or dispersing agents. Higher diffusion coefficient, lower viscosity (than water) of Supercritical CO2 and the absence of surface tension results in better penetration of the dye into the fibre," explains Dr Pankaj.

DYEING TECHNOLOGIES

Digital textile printing is an advanced form of flat bed or rotary printing of textiles whereas SCF dyeing is advancement in the dyeing technology. Digital printing is like any inkjet based method of printing colorants onto fabric. The amount of water used in digital printing is much less as compared to the conventional printing method." Plasma Dyeing uses the phenomenon of creating polarity (hydrophilic) in non-polar (hydrophobic) fibres with plasma treatment. Using gas plasma treatment, improved fibre surface properties without affecting the fibre`s bulk properties can be achieved by creating a polar layer on the fibre surface, thus introducing wet-ability of the fibre for dyeing. The concept uses the property 'of low sublimation disperse dyes' to transfer the dye from paper to polyester fabric using the thermal medium. Low sublimation dye is first printed on a specially coated transfer paper in the desired pattern; it is then run along with



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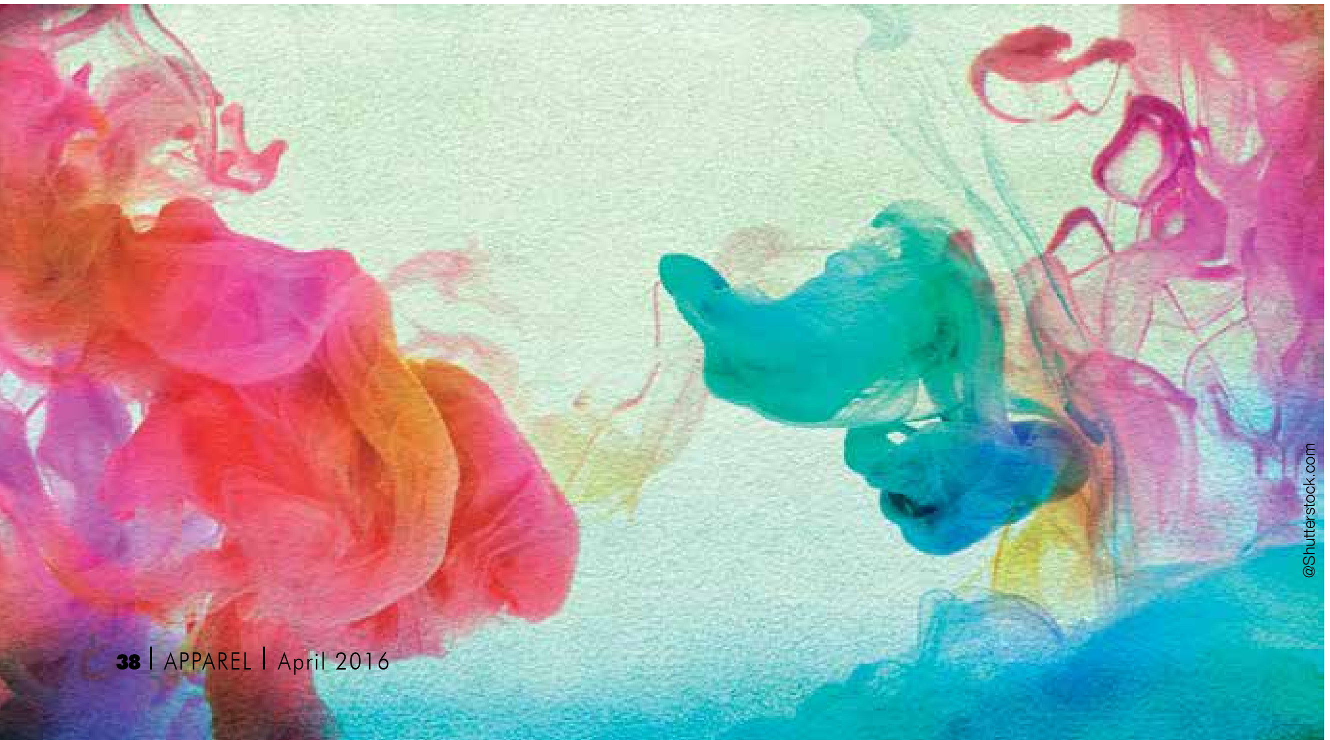

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the polyester fabric through a hot roller where the pattern is transferred on to the fabric. With digital transfer printing, the choice of colours is unlimited," says Dr Pankaj. Likewise in Foam Dyeing, foam used is a dispersion of a gas in a liquid. Generally, the liquid is water and gas is air or an inert gas. A fabric is padded with foam formed from an aqueous solution of a dyestuff, a foaming agent and a dyeing assistant. Padded fabric is maintained at an elevated temperature to fix the dye. The advantages of the process are low water/chemical consumption, improved dye migration of the dye into the fibre and higher colour yield.

ECOLOGICAL CONSIDERATIONS

Sustainability is important and the major brands in the industry see waterless dyeing and processing as a major step forward in textile processing. Supercritical carbon dioxide dyeing entails high pressure CO2 and safety; zero liquid discharge is 100 per cent water recycling, establish multistage evaporators for recovering salt and energy consumption and the saving of water. Dr Pankaj opines, "One can dye fabric with no water – CO2 emission, energy (40 per cent less than conventional), no chemicals or additives and no waste generation and such dyeing is done with supercritical carbon dioxide. Synthetic fabrics can be dyed with modified disperse dyes at 31ºC and 74 bar and its effects help in dissolving the compound and diffusion into the fibre. Scouring, dyeing and finishing can be done in a single bath and residual dye is very minimal (0.02 per cent) and can be reused. In the basic CO2 dyeing principle, 95 per cent carbon dioxide is recycled and reused and the dyed fabric is dried for ready use. The benefits are, lower operational costs, processing time (50 per cent) with less re-dyeing (98 per cent reproducibility) besides level dyeing, brilliancy of shade, fastness properties and no staining of adjacent fibres. Safety aspect – dark shade at 250 bar in automated controlled, designed and engineered machine (any leakage triggers an auto shut down), Life Cycle Analysis (benchmark Jet dyeing 2003, Best Available Technology 2010) of supercritical fluid was studied at the professional level. Key advantages are, the elimination of water, wastewater discharge and treatment, reduction in manpower." In conventional polyester dyeing, you need at least 30-40 litres of water per kg of yarn, whereas in SCF dyeing, the entire CO2 (95 per cent) is recycled and no water is used either in pre-treatment or after treatment. The SCF process consumes 40 per cent less power than the conventional dyeing system.

IN CONCLUSION

Carbon dioxide is considered the best supercritical fluid for the dyeing process. It is naturally occurring, chemically inert, physiologically compatible, relatively inexpensive and readily available. Other attributes of carbon dioxide are that it is an inexhaustible resource, non-flammable and non corrosive. The quality of CO2 is the same everywhere and it is non-toxic and low cost. It can be recovered (95 per cent) and reused from the dyeing process, there are no disposal issues. The major limitation of adopting the system today is the capital cost and batch size (not beyond 200 kg batches/tube). Here is hoping that technologies of this nature help to conserve water, a resource which is rapidly depleting and utmost attention needs to be given to its conservation. ■