▲ N1 dam (left) and Jalwal reservoir.

Back to the future

Cellulosic fibre manufacturer Birla Cellulose is aiming to create the industry's first ZLD (Zero Liquid Discharge) plant at the company's original viscose factory which dates back nearly 70 years.

Simon Glover reports

Retrofitting the very latest 21st century water reduction technology at Birla Cellulose's first viscose factory – the origins of which go back to Indian independence in 1947 – has proved every bit as challenging as it sounds.

But after overcoming several hurdles, the project to install the 4R – reduce, reuse, recycle and regenerate – system is well underway and the company, part of the Aditya Birla Group, confidently expects the **ZLD system** to be commissioned by early 2021.

Under the ZLD system, 96 per cent of water will be recovered, with zero effluent produced.

Water scarcity has always been an issue at the plant since it opened at Nagda, then a remote village on the banks of Chambal River, a tributary of the Ganges, in the central Indian state of Madhya Pradesh, in 1954.

The Indian government had invited the industrialist and philanthropist G D Birla to establish a viscose fibre facility there after much of the country's cotton-growing land, on the banks of the Indus River, was lost to Pakistan during partition.

The factory has subsequently gone from a twin line producing 15 tons of fibre a day to one with 11 lines and a daily capacity of 400 tons. Nagda itself has prospered on the back of this success, becoming a prosperous town with a population of 100,000 people.

But this rapid growth took up more water than the River Chambal could provide. Birla Cellulose set about building a series of dams and reservoirs to harvest water during the rainy season, as well as focusing on minimising its own water use.

> **"Water stress is the second most important issue facing the planet after climate change**
>
> *Dilip Gaur, business director, Birla Cellulose*

The company's business director Dilip Gaur explained: "Scarcity of water led to a series of innovations which have created the most water efficient factory in the global viscose industry - with the current project to install ZLD technology being another ground-breaking step.

"Water stress is the second most important issue facing the planet after climate change and as a leader in sustainability practices, we must commit to advancing the technologies in this area, and consider water stewardship as the critical part of our operations."

The reservoirs now actually hold more than three times as much water as the factory uses and act as a primary local water source, providing clean drinking water to about 200,000 people as well as irrigation for agriculture.

Mukul Agrawal, Birla's head of sustainability and strategic projects, added: "By creating a water positive ecosystem in the region, the whole area has been converted from a totally uninhibited barren land to a thriving town.

"The Nagda site has taken this challenge head on and had a very interesting journey on water, which not only supported its own growth, but has been the single most important factor in the socioeconomic growth of the surrounding region.

"The site not only optimised its own water consumption but also created massive infrastructure to harvest water which supports more than 30 villages around it.

"This is even more important as the groundwater in the area is not suitable for drinking due to high levels of fluoride. The water is also used for irrigation upstream of the dams making positive impact on agricultural productivity in the region."

Meanwhile, **water reduction innovations** at the Nagda plant, including closed loop technologies, wastewater mapping, water flow meters and sewage water recovery facilities, reduced the amount of water required to produce viscose by 70 per cent in just five years.

But, despite these achievements, Birla decided to embark on the unchartered path towards achieving ZLD, a water treatment process in which all wastewater is purified and recycled, leaving zero discharge at the end of the treatment cycle.

"A ZLD system for the viscose industry has never been developed and requires some special challenges which are unique. The effluent has high inorganic and organic content, with a high hardness, all of the components that membrane systems hate," added Agrawal.

"On top of that, the site has not been designed for installing the ZLD system and the current infrastructure and ETP (Effluent Treatment Plant) processes need to be retrofitted at several places in order to have a smooth running ZLD system.

"Industry leaders were invited to design the systems including the world's top three companies in membrane technologies. This was a challenge as no such ZLD system existed today that can handle all the nuances of viscose effluents.

"Finally after months of deliberations with these companies, a state-of-the-art ZLD system was designed which will be built on highly energy efficient technologies. The new system will allow the recovery of 96 per cent of the total wastewater feed."

The new system would incorporate a pre-treatment section where all effluent would be collected and treated to make it suitable for processing by membranes which had been specially designed to treat water with high inorganic and organic content.

Agrawal continued: "There are several remarkable technologies being applied at one place and by the first quarter of 2021, the viscose industry will witness another new technology which will set new standards within closed loop production processes and circular technologies in the viscose industry, making a step change in chemicals and water recovery.

"The complete scheme is fully automated and is also designed to minimise energy and chemical consumption. Post membrane separation there is a mechanical vapour compression system that recovers water from the concentrated brine solution.

"This is designed in a highly efficient manner. The next two stages recover the salts that can be used in several applications. The remaining highly concentrated brine is sent to a crystalliser to recover the remaining water.

"The best part of this design is that the whole process is designed in a way that maximum salts are recovered as usable and only a small solid waste is generated.

"The challenges were enormous but the results should be equally gratifying. The site will recover 96 per cent of the water from waste. There will be zero effluent and the site's environmental impact on the river will also become zero." ■

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> *Mukul Agrawal, head of sustainability and strategic projects, Birla Cellulose*

Less than 20 cubic metres of water is currently required to produce one ton of fibre – just 40 per cent of the lower limit of the European Union Best Available Technology (EU BAT) target range of 35-70 cubic metres of water per ton of fibre.

▼ Construction site of the ZLD system.