AcquaZERO – an Environment-friendly and Cost-effective Innovation.

Summary: *The efficiency of modern dyeing machines provides great advantages in terms of quality and cost effectiveness. Noseda engineers have developed a machine capable of reducing processing costs thanks to excellent reproducibility, quality and operating flexibility features.*

The machines and techniques used in textile dyeing processes show considerable differences according to the type of material to be processed.

In the case of yarns – apart from dyeing hanks and arm dyeing machines – the dyeing of wound goods of various densities and geometries, warp beams, cakes or other new package types such as those for stretch yarns, is carried out in autoclaves that allow the forced recirculation of the dyebath through the packages themselves.

In more general terms, dyeing machines for “wound goods” should include both yarn package and cloth beam dyeing equipment. However, the engineering principles of these two categories of dyeing machines are as much different as the application problems they pose. For this reason, and due to the fact that highly specific abilities are required in each field, the machinery manufacturers that are able to offer autoclave equipment handling yarns and fabrics are very few. Noseda is one of them.

Century-long experience

Established in 1893 and operating in the dyeing machinery sector since the beginning of the 20th century, Noseda srl is headquartered in Tavernerio, in the heart of the Como textile district.

Here, a range of machines are designed and built for the most demanding applications in industrialised countries (at least, those which still have a strong textile industry) and emerging countries as well.

The company’s R&D centre, renovated in 2004, offers interesting suggestions from this point of view, being home to a range of intense activities, both internal or on the behalf of Noseda’s customers who send materials to be tested and processes to be developed under strictly confidential conditions, accepted and adopted by the whole R&D staff.

The concentration of the company’s activities under one roof, the company size and organisation, all speaks for strongly customer-oriented products and services.

For this reason too, Noseda has long been known in the textile world for the innovative features of its technologies and the excellent performance levels of its machines.

The technical and commercial partnership with the Japanese company, Hisaka, confirms Noseda’s drive for innovation, fuelled by its proximity to customers of highly innovative spirit, and promoting the ongoing development of products and applications.

Water – a key factor.

In a number of industrial sectors, the enterprises are increasingly aware of the need to reduce water consumption down to a minimum during production cycles; in many cases, the results obtained are encouraging.

Unfortunately, the textile industry has not always been among the most virtuous industrial sectors from this point of view.

For example, in the reactive dyeing of cotton yarns, water consumption rates of up to 120 litres per 1 kg of fibres are rather frequent.

Today, with fresh water supply and wastewater disposal costs often reaching 1.5 €/kg and steam more than 3 €cents/kg, it is necessary to introduce radical measures by leveraging on all modern techniques available.

The need for flexible automation.

For a long time, the textile industry has relied on automation solutions characterised by a low level of industrialisation, and at the same time, by a high degree of rigidity.

Today, the textile industry too can find – through modern production systems – specific answers to the growing need for rationalisation, flexibility and lower costs.

Textile companies in Italy and Europe cannot stand up to their low-cost competitors if they continue to lose ground in terms of production costs (labour, energy, environment, etc.).

The relocation of production – now indispensable in the field of spinning and weaving – is not so necessary in the finishing stage thanks to the availability of a number of market niches and factors (quality, flexibility, and above all quick response) which can still make the difference in this particular segment of the textile pipeline.

From this point of view, the innovations offered by Noseda in the field of dyeing process engineering and automation represent an effective answer to the survival problems of European textile companies.

Machines with strongly innovative features.

The rapid development of technologies for yarn package dyeing has led Noseda to organise its production programme on the basis of three machine models, i.e. Base,

Advanced and Concept, now also available in the new AcquaZERO version.

Each one of the three pressurised versions (on request, equipped with double pump) has been built on a common platform which includes not only the operating principles, but also a range of standardised components of absolute quality.

The Base version is particularly suitable for users in areas where the cost of energy and water (fresh water supply and waste water disposal) is still affordable, the demand for flexibility is still much lower that in industrialised countries, and the yarn quality required is however within the generally accepted international standards.

The Advanced version instead permits the user to deliver higher requirements.

In terms of flexibility, the Flex 10 version allows the handling of a number of packages per carrier that can vary from 1 to the maximum possible at a “constant” liquor ratio – i.e. within the limits generally accepted on the market.

In the case of horizontal machines, the Flex 10 configuration eliminates one of the biggest problems inherent to this type of machine that is increasingly popular in newly built plants – the fact that the easy reduction in the number of packages loaded is hardly possible.

The SCR 2000, 3000 and 4000 systems also make it possible to tune the hydraulic components to the process in a straightforward and intuitive manner.

The Concept model in the Flex 10 version equipped with HPF-HS and SCR 3000 systems incorporates the techniques developed by Noseda in the early 2000s.

This platform has also provided the basis for the development of the AcquaZERO version which allows the dyeing of a variable number of packages at a preset liquor ratio, which is maintained at an absolutely constant (with evident benefits in terms of reciping and process setting up) and minimal level with a considerable reduction in energy and auxiliaries consumption costs.

MAF and the HS technology.

The hydraulic limits of a machine – even last-generation ones – and those of each application can be defined thanks by measuring the Maximum Allowed Flow (MAF) parameter (in the laboratory under “standard” conditions, i.e. replicating an industrial process).

It is not difficult to imagine the benefits associated with the use of machines allowing an increase in the specific liquor flow (l/min per kg) or in the number of liquor recirculation cycles (cycles/min): shorter cycle times, improvement of colour homogeneity, higher effectiveness of washing stages (higher solidity).

Overcoming the MAF limit is, therefore, the objective of all dyers, and doing this is evidently not only a matter of installed power but also of the extent to which this theoretical “power” is really exploited.

Putting it in auto racing terms, we can say that the possibility of using higher liquor flow (i.e. power) levels corresponds to the possibility of transmitting more power to the road surface when accelerating or bending. And the importance of auxiliary devices such as the ABS and ESP systems in the different types available today is recognised by all drivers, especially the most experienced and exacting ones.

Following a long research and experimentation work, Noseda has been able to demonstrate that the typical MAF value of any standard package or machine can be increased considerably using the HPF-HS versions equipped with SCR 3000 or 4000 system.

A cutting-edge version – the Concept AcquaZERO.

With the AcquaZERO version, the liquor ratio is no longer a variable depending on the yarn, the package or the machine load, but a constant factor defined and chosen by the dyer.

With some rare exceptions, the liquor ratio is often calculated with excessive approximation.

Measuring all the volumes involved, it is possible to observe (with the rare exception of the packages with density higher than 0.7 kg/dm^3 or of compressible packages) that liquor ratio are hardly inferior to 1:8-10.

Sometimes, limit values of 1:16-18 may also be reached, for example in the case of silk yarn packages with a density inferior to 0.1 kg/dm^3.

If we consider that the reactive dyeing of a cotton yarn wound on a rigid tube with a density of 0.32-0.38 kg/dm^3 dyed in medium-dark tones with reactive dyestuffs (90-60 °C cycle) requires from 10 to 12 filling-ups per cycle, it is easy to understand that the global consumption of water (liquor rate 1:10) cannot be inferior to 100-120 l/kg for each cycle, and, as a result, steam consumption cannot be inferior to 5 kg per single kg in each cycle.

Not considering the recipe costs and taking a global cost of water (from supply to disposal) of 1.5 €/m^3 and a cost of steam of 3 €cent/kg, we obtain a cost of 0.29 €/kg per cycle. If the same goods are dyed at a constant liquor ratio of 1:4, this cost will shrink to 0.14 €/kg per cycle.

However, the benefits are not limited to the above-mentioned ones. Other evident advantages are provided by easier reciping and production of the desired tone thanks to the really constant liquor ratio even when varying the package and machine load.

In relation to the dyestuff types particularly sensible to the variations of the liquor ratio, the possibility of reciping and producing more batches (even of different sizes) whether at full load or partial load with constant liquor ratio, considerably reduces the work in the laboratory as well as the interventions to correct the tone produced.

The effects of all this on the output rates are evident, with a dramatic reduction in cycle times (no corrections and no re-dyeing) and in industrial production costs.

Dyeing and automation at Filtex Como.

At the beginning of 2004 a new yarn dyeing plant by Noseda came on stream at the mill of Filtex Como Srl.

This dyeing company based in Como – an operation of Interfil Spa and of its Kreon division, both of them specialist in the trade of high-performance natural and synthetic yarns – decided to add to the existing Luisago unit a new independent plant prevalently dedicated to polyester yarn dyeing.

As a result, while the technical updating programme of the Luisago mill continued with the installation of the new Noseda Concept ranges, the installation of the newer Noseda Concept AcquaZERO models began at the Villaguardia dyeing mill, also incorporating an efficient high temperature and pressure dryer, as well as a package carrier loading/unloading and machine feeding/unloading system.

The joint efforts of Filtex Como, Noseda and Eutrolog (system partner of Kuka Roboter Gmbh) have allowed the finalisation of a project started by Noseda in the early 1990s. A project which has been ever since developed by the company, including increasingly performing and reliable components.

The result has been a modern robotised plant making the most of cutting edge technology, with reliable anthropomorphic robots and laser-guided vehicles (LGV) instead of conventional overhead frame systems with shuttles sliding on tracks along rigidly predetermined paths.

Today, the Villaguardia mill can be considered one of the most modern in the field of textile dyeing thanks to its automation level and to the AcquaZERO dyeing equipment.

Dyehouse automation.

The package carrier loading/unloading and machine feeding/unloading automation system is composed of various important components. First of all, an anthropomorphic palletiser robot, integrating a package, tube, divider and end cap feeder; then a laser-guided vehicle (LGV) for the transportation of the package carriers, also including a carrier storage system; lastly, the “brain”, i.e. the plant monitoring and management software.

The heart of the system is the 4-axis palletiser robot mod. KR180PA featuring a multiple head with five air-operated grippers, each having three self-centering fingers. This gripping head can handle packages, tubes, dividers and end caps.

The handling of the package carriers is carried out by the LGV that covers the whole path from the grey yarn carrier warehouse to the dyed yarn warehouse through the dyeing machines, the rapid dryers and the intermediate buffer storage areas.

The laser-guided navigation system of the LGV relies on a number of reference points (cat’s eye reflectors) placed on walls or other objects along the laser-guided path.

The LGV is equipped with a laser head scanning the entire operating area around it, allowing the identification of its current position.
It is evident that the main advantage offered by the LGV system lies in the easiness and freedom of configuration and layout of the dyehouse.

As laser guidance is a surface piloting technique, the LGV path can be modified by simply changing the path instructions, therefore, without modifying any fixed installation.

In addition to this, another important aspect regards the plant logistic. Unlike conventional “horizontally-laid” solutions, Noseda carriers – when empty or when full and awaiting for the dyeing and drying stages – can be stored on “vertical” warehouse shelves with up to three levels (the last one positioned at max. 4.2 m from the ground) and length according to the number of the package carriers to be handled.

The anthropomorphic robot and the management system are controlled by a plant monitoring software system which, in addition to coordinating all missions, enables the operators to manage machine priorities by using special access keys, as a result providing additional flexibility.