

Fongs Group: Ecological dyeing solutions to reduce the water consumption

In 1992, the United Nations General Assembly designated 22nd March as "World Water Day". Every year on that date, people worldwide participate in events and programs to raise public awareness about the critical lack of clean and safe drinking water supplies—and to promote the conservation and development of global water resources. The textile industry consumes huge volume of water everyday and the dyeing industry is undoubtedly one of the industrial sectors that threaten the safety of drinking water. In an effort to save the precious water resource and reduce the environmental impact, Fong's Industries Group along with its member companies, namely Fong's National, THEN, Goller and Fong's Water Technology provide an ecological dyeing solution to reduce the water consumption drastically through their innovative technologies covering the processes from yarn dyeing to piece dyeing and recycling of discharge after dyeing and finishing.

Yarn Dyeing Process – Fong's ALLWIN High Temperature Package Dyeing Machine

Yarn dyeing is nothing more than imparting colour to the yarn, that will soon be used in knitting or weaving projects, however, it consumes an enormous quantity of water and electricity at the dye houses, which compels the industrial manufacturers to find an environmental solution to revitalize their competitiveness.

Fong's ALLWIN High Temperature Package Dyeing Machine (Fig.1) offers liquor ratio as low as 1:4 with its integrated design of REV centrifugal pump, heat exchanger and the flow reversing system (patent granted). The newly designed integrated circulating system results in space saving by approx. 25% as compared with conventional machine arrangements.

With the capacity ranging from 28 kg to 9129 kg, ALLWIN is equipped with AIR+ Advanced Intelligent Rinsing System, which shortens the processing time for cotton yarn to 276 minutes, the total water and electricity consumption for dyeing medium to dark shade yarns are reduced to 34 l/kg and 0.43 kWh/kg respectively, consequently a significant saving on water and electricity consumption by over 40% and chemical cost by 19% as compared with conventional machines.

The ILC Intelligent Levelling Control System monitors the water flow through the package from outside-in to inside-out and vice versa. The ILC improves the levelling of colour through out the whole package thereby reduces yarn loss and increases reproducibility from batch to batch. The outstanding performances of these features save total production cost by 30%, making it a premium choice for yarn dyeing facilities everywhere.

Discontinuous dyeing processing – overflow and airflow dyeing machines

1. Fong's Jumboflow High Temperature Dyeing Machine

Despite the new technologies being introduced to the industry over the past two decades, the overflow dyeing machines are still widely used in the knitted fabrics segment. Fong's National has constantly endeavored on the product development and research to meet the great demand from the customers for eco-friendly dyeing machines with low water and energy consumption to face the rising competition in the textile sector. Recognizing this market demand, Fong's National has launched latest JUMBOFLOW series (Fig. 2) High Temperature Dyeing machines, which are the most economic hydraulic dyeing equipment ever developed for the industry.

It is suitable for the processing of light to heavy weight fabrics with the lowest liquor ratio of 1: 4.5 to run the machine.

The JUMBOFLOW series machine is rigged with the Multi Saving Rinsing System (MSR), which allows the dyeing process to carry out cooling and rinsing simultaneously. For those dye houses without recycling of cooling water, MSR reuses the cooling water discharged from the heat exchanger directly and carries it back to the machine for the rinsing purpose. This avoids the direct discharge of the cooling water and hence reduces the water consumption considerably.

In order to rinse fabric effectively, the quantity of rinsing water and the rinsing time must be controlled, the AIR+ Advanced Intelligent Rinsing System is developed for this purpose to improve the rinsing efficiency. With the aid of flowmeter and modulation valve, the flow rate of filling water can be controlled automatically. During the rinsing process, the conductivity of the electrolytes in the dye liquor (in ppm) is actively monitored. The rinsing process continues until it arrives at a particular TDS (total dissolved solids) value (standard before soaping: 2000ppm = 2g/L Na₂SO₄). As the usage of the alkaline is directly proportional to the TDS value, and the TDS value is also proportional to the usage of acetic acid, according to the



Fig. 1: Fong's ALLWIN High Temperature Package Dyeing Machine.



Fig. 2: Fong's Jumboflow High Temperature Dyeing Machine.

Equivalent Weight Principle, it does not only guarantee the performance of neutralization by acetic acid, but also save water consumption and process time by approximately 40% and 33% respectively as compared of these with conventional dyeing machines.

2. THEN-AIRFLOW® Dyeing Machine

The researchers at THEN had already predicted the situation of increasing scarcity of usable water as far back as the 1970s, when they began developing a jet dyeing system that would dramatically save water. The basic idea was to use dye liquor for the sole purpose of dyeing the fabric, and not to waste copious amounts of it, to simply move the fabric through the kier. They achieved this by harnessing the air inside the dyeing vessel and use it as a jet stream to propel the fabric through the dyeing nozzle. Thus, the THEN-AIRFLOW® concept was born, and it became an immediate success initially in Europe and America in the 80s and 90s of the last century. Today, the global success story of the THEN-AIRFLOW® continues, and it has become the most popular brand of exhaust dyeing machines even in China.

As air is used to move the fabric through the machine, the liquor ratio required in THEN-AIRFLOW® machines (Fig. 3) is typically 30% to 50% lower than in hydraulic round vessel dyeing machines. For 100% cotton fabrics, it is typically 1:3.75 at full loading, and even at half loading, 1:4.6 is achievable, as the THEN-AIRFLOW machine works without a liquor bath in the bottom of the kier.

The significantly lower amount of water in circulation also means considerably lower requirements of auxiliary

chemicals and, in reactive dyeing, particularly of Glauber's salt. Dyeing of most synthetic fabrics can be effected without the use of anti-foaming agents.

Over and above this, the lower liquor ratio also offers a higher efficiency of dyestuffs. In THEN-AIRFLOW® technology, the dyeing point is in the nozzle. By injecting the dyeing liquor into the airstream transporting the fabric through the nozzle, an aerosol mist is created that offers dyestuff penetration far beyond the reach of any dye bath.

In reactive dyeing, customers achieve annual savings of around 5% on their dyestuffs bill. The low liquor ratio and low overall water consumption also mean that total cycle times are greatly reduced. For a 100% cotton fabric in a dark red (maroon) shade, the total process time including loading, pre-bleaching, reactive dyeing, washing-off, rinsing and unloading is 278 min. This means a theoretical batch rate of 5.2 per day and thus a massive improvement in productivity over old technology. The overall water consumption for this fabric from loading to unloading is 39 l per kg.

In pure bleaching operations, THEN-



Fig. 4: Goller Colora Dyeing Range.

AIRFLOW® machines achieve water consumption figures of 8 litre per kg for RFD (ready-for-dyeing) and 9 litre per kg for optical white.

THEN-AIRFLOW® machines are available as high-temperature models or as atmospheric machines. There are presently more than 2,500 units of late design in operation worldwide, offering their respective owners economic and ecological superiority on both woven as well as knitted fabrics across all natural and man-made fibre contents.

THEN-AIRFLOW technology is unrivaled as the most economical exhaust dyeing technology and the most ecologically sound solution in the industry: it offers the smallest water footprint of any exhaust technology available today.

3. Continuous Wet Processing – Goller Colora Dyeing Range

Goller has been one of the leading manufacturers of continuous wet finishing lines for woven and knitted fabrics. Compared to discontinuous processing machines, it is evidenced that all Goller products have a lower consumption of water, steam and chemicals. This is also valid for the dyeing process of wovens on the pad steam range Colora (Fig. 4) as well as for Goller washing range Sintensa for knits after CPB dyeing.

In order to protect the environment and to save previous resources, Goller engineers are trying to reduce the water consumption as far as possible. Especially in the field of intensive R&D, Goller has made a significant progress. All ranges of Goller are equipped with a state-of-the-art computer program, which controls and regulates the whole setting of the machine.



Fig. 3: THEN-AIRFLOW® SYNERGY G2.

For Goller machines, it is obvious that the liquor content in the different washing compartment is reduced to the absolute necessary minimum. This is important when the production line has to be emptied and refilled, when changing the colour which has to be dyed / when changing the colour for dyeing process. This means that in the **Effecta compartments for woven fabrics**, the bottom guide rollers are submerged only by 2/3 of its diameter. Besides the reduced filling quantity, it also optimizes the usage of the water. Between guide roller and fabric a hydrostatic pressure is created which increases the crossflow through the fabric and increases thus the washing efficiency.

In the **Sintensa compartments for knitted fabrics**, where the fabric is carried through the compartment, this crossflow is created by mechanical means. A driven rotor with a special surface shape pushes the washing liquor through the fabric.

Another important feature to save water is the consequent counterflow inside the washing compartments. Through meandering cascades, it is made sure that no dead zones exist and no accumulation of impurities or concentration differences occur. Depending on the dyeing process this counterflow is also applied between different compartments.

With the consequent reduction of process water the side effects are obvious: Less energy is needed to heat the process water which in a dyeing range requires up to 98°C. Thus costly energy is saved at the same time, but also less water discharged to the drain means less treatment costs for the effluents.

Huge potential for cost savings exist nowadays in the continuous finishing of knits, which is not so common yet with other manufacturers. Goller is supporting especially these customers with technological and technical support to achieve the potential savings for the benefit of the customers, but last not least for the environment.

Reduce Discharge from the Start till the End – Fong's Water Technology's Water Reuse System

Despite all the innovative ecological dyeing systems being provided, water consumption in dyeing process is still large. It would be best to treat discharge which can then be used back into the dyeing process, which ultimately lowers new fresh water intake and the discharge volume.

Since the water used in textile manufacturing must be non-staining, water to be reused must be low in turbidity, colour,



Fig. 5: Pilot Test Unit of Fong's Water Technology.

iron, and manganese. Hardness may cause curds to deposit on textiles and causes problems in processes that use soap.

As such, water to be reused must first go through a desalination process that reduces its hardness and impurities. Reverse osmosis, an advanced treatment process materialized through modern-day membrane technology, is most commonly used in water reuse to physically remove salt and impurities from wastewater.

Water Reuse systems provided by Fong's Water Technology has unique characteristics and advantages in water impurities removal.

Membranes, used with the combination of other traditional filtering processes, can efficiently retain microscopic elements, and lowers the content of organic materials, colour, water hardness and other undesirable substances in wastewater.

As the membrane technology matures, cost of membrane element has decreased, while the performance of such procedures have increased considerably. Treated water can readily be reused in production, reducing water costs, discharge costs, hence reducing operating costs.

Installing a water reuse unit (Fig. 5) is definitely not a plug-n-play business, and need a tailor-made solution to ensure optimal performance. The implementation of water reuse system is in three phases:

1. Preliminary water test: Around 2 to 3 Liters of water sample is collected for water quality analysis. A few characteristics of the effluent are evaluated, including conductivity, total dissolved solids (TDS), pH, Colour, Turbidity, and Chemical Oxygen Demand (COD).

2. Pilot Test: With the pilot test unit running in client's site for around one month, it should cater most of the challenges that the full system may encounter, and engineers collect the information needed for fine-tuning the proposed solution hence provide a better final implementation for the customers.

3. Full implementation: With the water sample analysis and pilot test carried out, it should now pretty confident that the final solution will operate in an effective and efficient manner.

Gearing Up for Future Challenge

The issue of water and energy savings is currently a hot topic worldwide, the discussion has been also very much in vogue in textile industry.

The fierce market competition nowadays has resulted in a lower profit margin in the dyeing and finishing industry.

To stay competitive, the manufacturers have become much more environmentally conscious than ever and started to apply the innovative product technology to reduce their water and energy consumption, thus, help to slow down climate change.

Looking ahead, Fong's Industries Group will uphold its commitment to serve the industry with the best environmental solution covering the quality products and cutting-edge technology to help the industrial manufacturers to achieve the balance between the operating target and environmental stewardship. ♦