

Business Case: Automatic Chemical Dosing

Support to Safety Retrofits and Environmental Upgrades in the Bangladeshi Ready-Made Garment (RMG) Sector

It is Worth to Automate Chemical Dosing

In order to prepare clean and dye fabrics the textile industry uses substantial quantities of chemicals. To avoid or minimise spillage and overuse of hazardous chemicals accurate weighing, dispensing and mixing are fundamental.

Advantages of Automatic Dosing and Dispensing at a Glance:

- Improved right-first-time performance
- Increased machine efficiency
- Reduced purchased chemical requirements/ minimization of chemical residue
- Reduced wastewater pollution
- Improved workplace safety

ing and mixing are fundamental.

In the recent years there have been great improvements in the automation of chemical dosing and dispensing. New microprocessor-controlled dosing systems can meter chemicals automatically according to a variety of profiles, such as constant rate or variable rate. This improves the efficiency and reliability of chemical reactions in the dye bath, ensuring results that are more consistent and reproducible.¹

Moreover, in modern dosing and dispensing systems, the water used for washing the preparation vessel and supply pipes is taken into account when the quantity of liquor to be prepared is calculated. This approach reduces wastewater, but still involves premixing of chemicals.

Other automated dosing systems that are available do not pre-mix the chemicals before introducing the same to the applicator or dyeing machine. In this case, individual streams are used for each of the products. As a result, there is no need to clean the containers, pumps and pipes before the next step, saving even more chemicals, water and time.

The most advanced systems allow on-line real-time preparation, dosing and application of each of the individual chemicals, making manual measurements obsolete and avoiding liquor residue. The high precision can be especially relevant for processes where very small amounts of chemicals have to be metered as modern automated dosing systems can dose amounts of powders as small as 0.8g.

Chemical dosing systems help enhancing an improved first-time-right performance. At the same time, they also contribute to a safer and healthier work environment since workers do no longer need to manually handle potentially toxic and hazardous substances.²

Depending on the number and capacity of machines, the investment costs usually vary between BDT 70 lakh - BDT 2.5 crore.³ Taking into account the reduced consumption of chemicals and water as well the increased efficiency, the installation of an automatic chemical dosing and dispensing system can result in annual cost savings of up to 30% which usually outweighs the initial investment for the system.

Detailed information about the cost and benefits of chemical dosing and dispensing systems can be found on the next page, followed by a case study example on page 3. Technical details on the installation and implementation process as well as legal requirements and possible means of financing can be found on pages 4 to 5.



A Production Officer monitoring the Chemical dosing process at DBL Group, Gazipur

¹ US EPA (1996). Pollution Prevention in the Textile Industry

² European Commission (2003) Reference Document on Best Available Techniques for the Textiles Industry

³ UBA (2003). Best Available Techniques in Textile Industry

Saving Chemicals, Improving Efficiency

Automatic chemical dosing and dispensing systems let the factory realise significant saving potentials. Potential benefits are shown in the table below:

Benefits:

Reduced chemical purchase requirements/ minimization of chemical residue	Automatic dosing and dispensing systems precisely calculate the amount of chemicals needed. Chemical residues at the end of the process can be minimised or completely avoided. Experiences from a dye house with a production capacity of 5000tonnes per year show that around 11.2% of chemical cost can be saved per year that way. ⁴
Improved right-first-time performance and machine efficiency	Exact dosing and dispensing of dyes and colours as well as tighter control of the process allows for improved right-first-time performance. Correspondingly corrective measures such as reworks, re-dyeing and stripping or shade adjustment can be minimized. Studies show that a dye house with a production capacity of 5000 tonnes per year can reduce its re-work rate from 4.5% to 3.7% through installing an automatic dosing system. At the same time the dye machine efficiency improves by 5%. Experience from an Italian textile manufacturing company shows that following the installation of an automated dosing and dispensing system for dyes and auxiliaries the need for sampling operations on the batches could be eliminated and replaced with an extra daily batch on each machine. ⁵
Improved workplace safety	Automatic measurement, dosing and dispensing of chemicals eliminates the need for direct human contact with potentially hazardous substances. This results in a safer and healthier working environment by avoiding the risk of adverse health effects (and health related costs) from exposure to chemicals in mixing and dosing operations.
Reduced labour costs	Highly automated systems require qualified personnel. However, the system can usually be easily operated by just one operator. Experience shows that labour cost in a dye house can be reduced by up to 10% after installing an automatic dosing and dispensing system.
Reduced water treatment costs	Automated systems with just-in-time preparation of liquors and separate dispensing of the different chemicals minimise or avoid chemical residues that would otherwise need to be treated in an effluent treatment plant at the end of the process. ⁶ Due to this, a significant reduction of waste water pollution and wasted chemicals can be achieved.

Calculating the Cost of an automatic dosing system

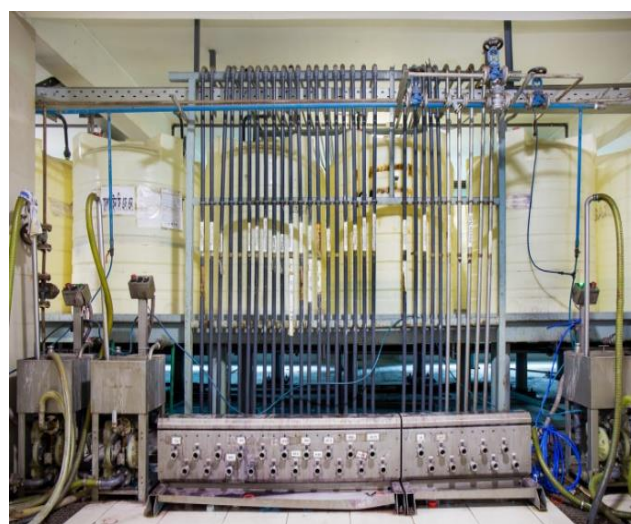
The cost of an automatic dosing and dispensing system depends on the number and capacity of machines, quantity of liquors to be prepared and the number of chemicals to be used. Investment costs usually vary from BDT 70 lakh to BDT 2.5 crore.

All system components such as tanks and pumps can be maintained by trained factory maintenance personnel. The average annual maintenance cost is expected to be less than 3% of the initial investment.

The following table shows possible investments for the installation of a dosing system on the example of a medium sized textile factory in Bangladesh(15-ton processing capacity per day):

Possible investments for chemical dosing systems:

Type of Investment	Quantity	Average Cost per Unit (BDT)
Chemical tank (1000L)	40	1.75 lakh
Foot valve	40	8,000
Pump	3	66,000
Injector	40	20,000
weighing device	1	80,000
Control Unit	1	1.3 crore
Piping & Hoses	n.a.	20 lakh
Average Total Costs		BDT 70 lakh - BDT 2.5 crore



Lawer, Auto Chemical dosing system

⁴European Commission (2003) Reference Document on Best Available Techniques for the Textiles Industry

⁵European Commission (2003) Reference Document on Best Available Techniques for the Textiles Industry

⁶European Commission (2003) Reference Document on Best Available Techniques for the Textiles Industry

Case Study Spotlight: DBL Group, Gazipur, Bangladesh



Partial outer View of DBL Group

Description of the Factory

DBL Group (DBL) is a diversified business entity which has vertically integrated textile and apparel manufacturing facilities. The DBL Group started its business in 1991 and has expanded its operations up to 22 factories by 2018. Currently, the group is one of the largest textile and garment manufacturers in Bangladesh and 100% export-oriented. Moreover, DBL has earned high reputation for embedding sustainability at the heart of the organisations strategy and incorporating it in the core production processes. The company employs over 32,000 workers and had an annual turnover of BDT 3,657 crore for the year 2015-16.

Colour City Ltd is one of DBL Group's dyeing units, located in Gazipur, Bangladesh with an operating capacity of 1,400 tons of fabrics per month.



Production Officer monitoring the whole Chemical Dosing Process through the Sedo Master, Sedo poing & Lawer System Software

Implemented Measures

Colour City Ltd installed an Automated Chemical Dispensing system in 2014 to streamline the allocation of chemicals to its twenty-nine (29) bulk dyeing machines in the production floor. The system can separately dispense up to thirty-one (31) auxiliary chemicals to a maximum of fifty-eight (58) machines according to the dyeing programme of the machine. The system is

equipped with thirty-one chemical tanks with a capacity of one thousand litres (1000 l) each for the preparation of chemical mixes. The chemicals are pumped through two interchangeable supply lines with two pumps and one booster pump each.

The time needed for the implementation was around five (5) weeks including the installation and all necessary construction work.

Investments and Savings

In total DBL invested approximately BDT 25 crore in equipping Colour City with an Automated Chemical Dispensing system. Besides the initial investment, maintenance plays a vital role to ensure optimal working conditions and conserve the lifespan of the newly acquired equipment. To ensure the equipment is maintained professionally DBL entered into three years' service contract with its supplier Environmental & Textile Solutions (ETS). Since the installation of the Automated Chemical Dispensing system in 2014 DBL has spent BDT 5.45 lakh for maintenance including the purchase of spare parts.

Although the cost savings of the investment described above are obvious, DBL has not yet calculated the total gains resulting from the financial savings in combination with the increase in productivity and product quality.

Challenges in implementation

At first, Colour City experienced some difficulties dispensing higher density chemicals as the proper concentration of chemicals required for the Automated Chemical Dispensing system needed to be adjusted. As DBL pioneered this automated system, the engineers also took some time to get to know the system and learn how the equipment functions. Moreover, the employees needed to build trust and confidence in the performance of the new system.

Key Performance Measures

Installing the Automated Chemical Dispensing system resulted in multiple benefits for DBL Group. Besides a more efficient use of the chemicals, **DBL was also able to reduce the reprocessing rate by about 2-3%.** Moreover, **DBL reported that the quality of the printing increased significantly while the cycle time could be shortened.**

With the introduction of the Automated Chemical Dispensing system, DBL also improved workplace safety as chemicals are no longer handled manually on the production floor. This significantly reduced the risks of workplace accidents involving hazardous chemicals such as chemical burns or health problems caused by inhaling chemical dust or vapours. Accidental chemical spills that frequently occurred before having been drastically reduced. Due to improved workplace safety DBL observed a significant reduction in Colour City's turnover rate.

The automated system also requires less manpower to dispense the chemicals which means that the number of workers needed during this process could be reduced. However, two new engineers were employed to operate and maintain the system.

Due to additional power consumption of running pneumatic systems, the electricity bill on Colour City Ltd. increased.

References for advanced chemical dosing in Bangladesh

Although there are no direct regulations governing the efficient use of chemicals in Bangladesh yet, there are guidelines which address the permissible maximum concentrations of chemicals in industrial discharge water.

In accordance with the guideline for assessment of effluent treatment plants published by Bangladesh Department of Environment (DEO) and the national standards for waste discharge quality at discharge point for industrial units and projects following standards have to be met:

Parameter	Unit	Maximum value ⁷
Ammonia (free ammonia)	mg/L	5
Ammoniacal Nitrogen (as N)	mg/L	75
Arsenic (As)		
BOD5 20°C	mg/L	250
Boron (B)	mg/L	2
Cadmium (Cd)	mg/L	0.5
Chloride (Cl-)	mg/L	600
Chromium (hexavalent Cr)	mg/L	1.0
Chromium (total Cr)	mg/L	1.0
COD	mg/L	400
Copper (Cu)	mg/L	3.0
Cyanide (CN)	mg/L	2.0
Dissolved Oxygen (DO)	mg/L	4.5-8
Dissolved Phosphorus (P)	mg/L	8
Electrical Conductivity	µMho/cm	1,200
Fluoride (F)	mg/L	15
Iron (Fe)	mg/L	2
Lead (Pb)	mg/L	0.1
Manganese (Mn)	mg/L	5
Nickel (Ni)	mg/L	1.0
Oil and Grease	mg/L	20
pH		6-9
Phenol Compounds (C6H5OH)	mg/L	5
Ammonia (free ammonia)	mg/L	5
Ammoniacal Nitrogen (as N)	mg/L	75
Selenium (Se)	mg/L	0.05
Sulfide (S)	mg/L	2
Temperature – Summer o C	°C	40

⁷Disposal in public sewer

Temperature – Winter o C	°C	45
Total Dissolved Solids (TDS)	mg/L	2,100
Total Kjeldahl Nitrogen (N)	mg/L	100
Total Suspended Solids (TSS)	mg/L	200
Zinc (Zn)	mg/L	10



An operator using the Commanding Device of Sclavos ATHENA 3D used at Fabric Dyeing

Leading brands in the textile industry have also recognised the need to limit hazardous wastewater discharges from textile manufacturing processes. This has been driven both by heightened public scrutiny and the desire by industry leaders to be good stewards of the planet's resources. As a result, several multi brand consortia such as the American Apparel and Footwear Association (AAFA), the Business for Social Responsibility (BSR) or the Sweden Textile Water Initiative (STWI) as well as most of the major textile brands (e.g. H&M, C&A, Levi Strauss & Co, etc.) have published waste water guidelines. Further information on international good practice standards regarding wastewater discharge quality can for an instance be found in "Textile Industry Wastewater Discharge Quality Standards 2015" provided by the Zero Discharge of Hazardous Chemicals Program.⁸



Digital Weight Balance, used for material weighing

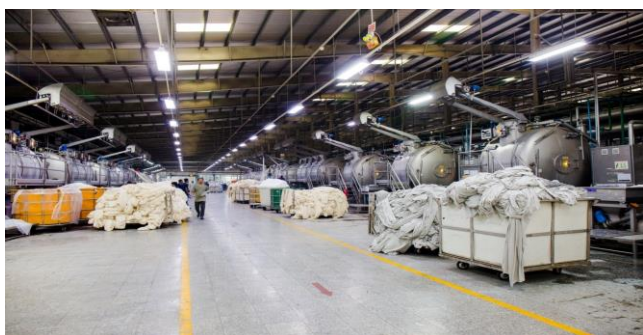
⁸ZDHC (2015). Textile Industry Wastewater Discharge Quality Standards

Key Steps Required for Implementation

As per experience, the installation of an automatic chemical dosing system will approximately take 1 –1.5months⁹ (including planning and design).

To evaluate whether or not an automatic chemical dosing system is feasible option for your factory the following factors should be taken into consideration:

- **Type of installation:** Automated dosing and dispensing techniques are usually applicable to both new and existing installations. However, highly sophisticated techniques such as dosing systems based on the colour-on-demand principle and automated laboratories are still very expensive and therefore more suitable for large installations.
- **Plant size and age:** Plant size and age represent no limitation for dispensing systems in general. Examples of plants with production capacities ranging from 5t/dayto70t/day are available.
- **Availability of space:** In case a high number of dyes are used, the system may require a lot of space for the individual chemical containers which may pose a challenge for companies operating out of premises with limited space available. In such cases, the system may be limited to colourants that are used more frequently (those with average highest consumption).



A fabric dyeing factory floor at DBL Group

Availability of Materials in Bangladesh

The required materials can be sourced via local or international traders. You may contact the DBL Group for their recommendations regarding possible suppliers.

Nature of Services Required to Support the Implementation

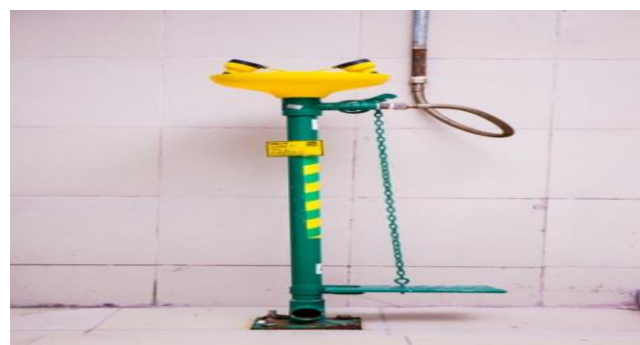
- Installation services are usually provided by the supplier and/or external experts
- Maintenance services for the systems can be carried out by skilled internal staff
- The installation needs to be supported by training of production personnel by the system supplier.

⁹Information acquired on site at Colour City Ltd.

Possible Sources for Financing

SREUP credit line could be a good source of financing for such an investment.

Main Feature of SREUP Credit Line	
Loan Type	Normally Term Loan
Discount	Provision and possibility of 20% discount from loaned amount
Loan Tenure	3-5 years in general and in special case up to 7 years
Loan Limit	Normally up to 1 Million Euro and can be increased up to 3 Million Euro in special cases
Interest Rate	7% p.a. (maximum)
Grace period. Debt: Equity Ratio Repayment	All issues are subject to agreement between borrower and lender



Eye Washer Station, used for Eye Washing



Sclavos ATHENA 3HT Fabric Dyeing Machine