BIELLA SHRUNK PROCESS
INNOVATIVE ATTITUDE

KINETIKA: DYNAMIC WASHING LINE

Introduction
Each and every industrial washing process is the result of the combination of 4 variables:

- Time
- Temperature
- Chemistry – detergents and other washing agents
- Mechanical action

The four above components need a specific adjustment according to the washing process that has to be carried out: this depends on which substances have to be removed (oils, sizes, waxes, dirt deposits, dyestuffs, pigments), as well as on the type of fabrics to be washed (weaving structure, composition, weight, yarns count).

Any lack, deficiency or wrong setting of one of the above mentioned variables, may result into a negative or insufficient effect on the final result.
The modern continuous open width washing lines offer a sophisticated process control over the treatment variables, but at the same time the mechanical action of the fluids is very moderate or underused.

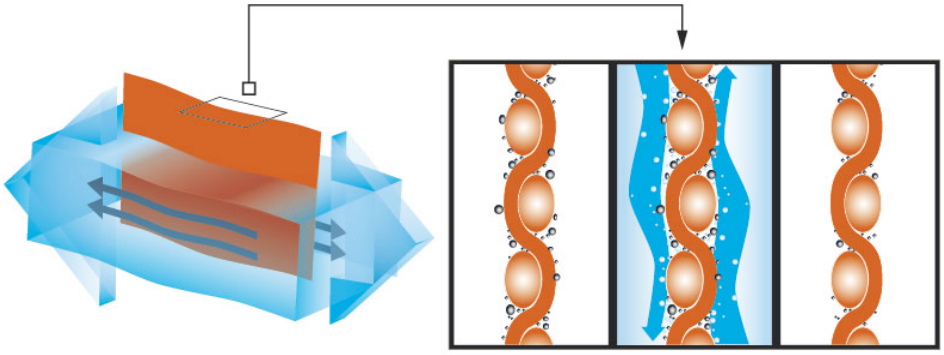
These modern washing lines do not simply need to remove the unwanted substances from the fabric, but have to carry out a delicate finishing process aiming to safeguard the characteristics and qualities of each fabric.

This document introduces the results obtained from studies and R&D carried out by Biella Shrunk Process in relation to an innovative continuous open width washing equipment named Kinetika, which is able to exploit the water mechanical dynamic action in order to achieve a deep and efficient washing effect, able to remove any external substances without any drawback that could affect fabric integrity.

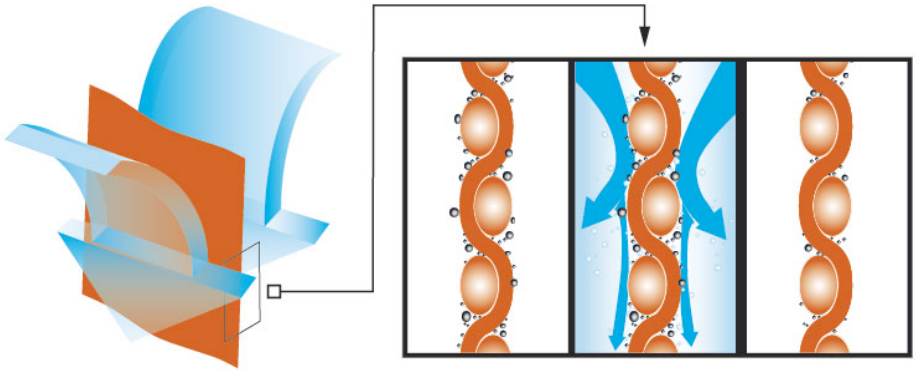
Initial hypothesis

The primary idea at the base of the Kinetika project is to increase the so called “interchange”, which means the ratio between the fabric mass and the water solution mass, that is the higher this ratio, the higher the washing efficiency.

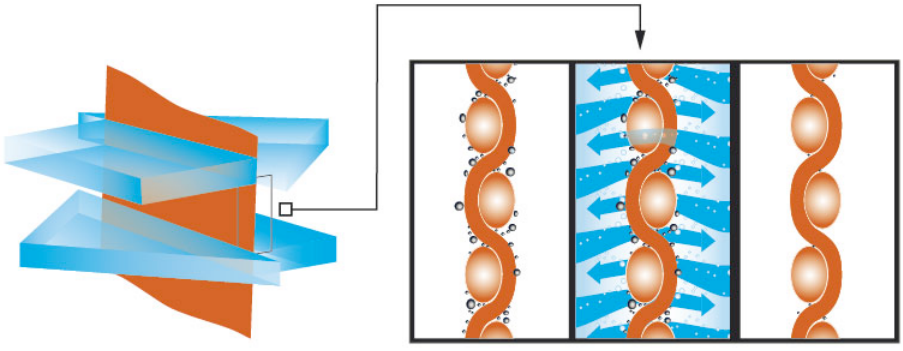
To obtain an efficient interchange, it is not enough that the washing fluids circulate inside the washing tanks, or flow over or bounce back on the fabric, but a real interaction is required and this is ensured only by a proper mechanical component that lets the fluids pass through the fabric. In order to increase the “interchange” effect, it is necessary to maximise the water speed component, thus its kinetic energy.



fluid circulation around the fabric = poor interchange



fluid bouncing or sliding over the fabric = poor interchange



Kinetika's fluid passing-through the fabric = high interchange

Adopted solutions
fluid bouncing or sliding over the fabric = poor interchange
Kinetika's fluid passing-through the fabric = high interchange

To exploit the kinetic component, the machine is fitted with over 700 nozzles facing the fabric, with a specific counter-flow positioning: this enables the fluid to reach the fabric, through the flat jets, at a speed up to 32 m/sec at the maximum pressure of 15 bar.

Figure 1 below shows a frontal view of a washing section illustrating the arrangement of the nozzles with respect to the fabric; this distribution has been designed to ensure a uniform coverage and an even washing throughout the entire fabric width.

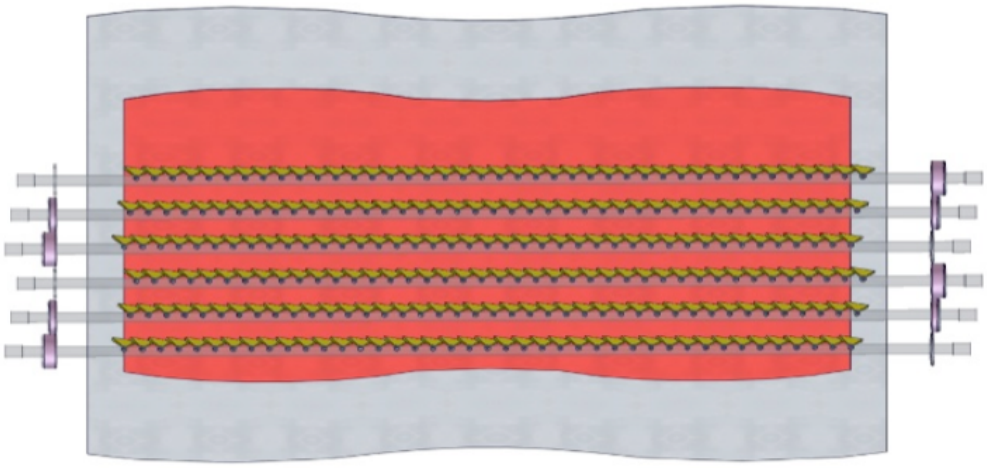


Fig 1 - bars and nozzles disposition in respect of the fabric / frontal view

Increasing the kinetic energy component in a continuous washing line involves the risk of affecting the fabric quality: the mechanical action could deteriorate the fabric features by forming wrinkles and creases or by generating elongations.

In order to avoid these inconveniences, Kinetika is fitted with two permeable conveyor belts made of a monofilament yarn using a spiral technology, which allows an invisible non-marking joint; the belts transport the fabric through a washing path in the form of a 3-layer sandwich (fig. 2). This solution prevents any possible elongation while maintaining the fabric perfectly flat during the dynamic high pressure deep washing process (Biella Shrunk Process international patent).

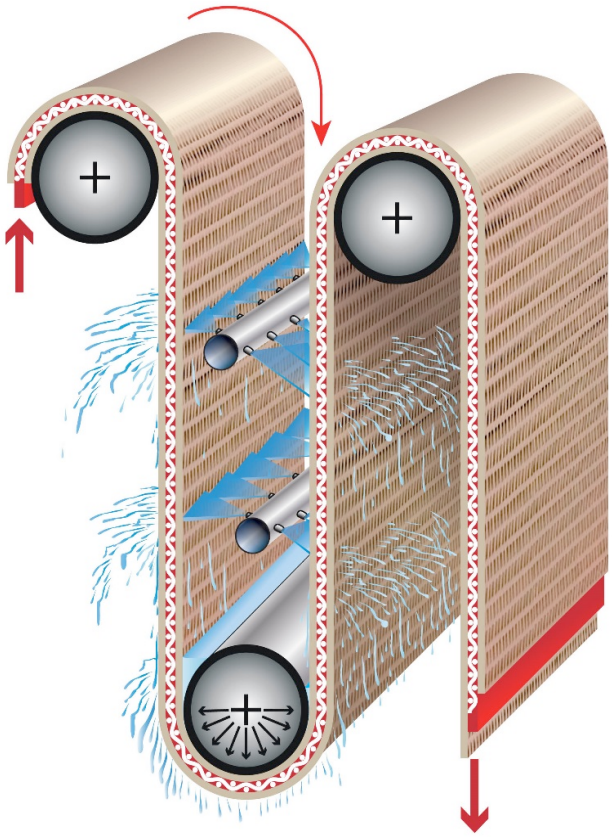


Fig. 2, three-layer sandwich

Washing process
The Kinetika washing process is carried out in at least 4 distinct units as follow:

- Entry section where the fabric is taken from the roll or trolley and prepared to the impregnation with a double spreading bar and an automatic centring device; a brushing unit is available as optional.
- Soaping section composed of a *Tandem* double-tank fitted with submerged slat drums and upper motorized rubberized rollers with lifting counter-rollers to increase the wetting and soaping action. To accelerate detergency, the washing fluid inside the tank can be oxygenated by using a special pump that spreads air bubbles through dispensing perforated pipes
directed towards the fabric; this section ends with a water-extraction device (2 roller pad mangle or vacuum bar)
- Washing and rinsing consisting of the Kinetika module fitted with a pair of permeable conveyor belts, 16 high pressure spraying bars, 3 pumps, self-cleaning rotating filters, pre-filtering belt, a set of stainless steel rollers, which determine the washing route and 2 collecting tanks; inside this unit 3 distinct fluid circuits are responsible for the washing, pre-rinsing and final rinsing phases. When leaving the conveyor belt, the fabric is squeezed (or sucked) to remove any water excess.
- Exit unit composed of folding arms

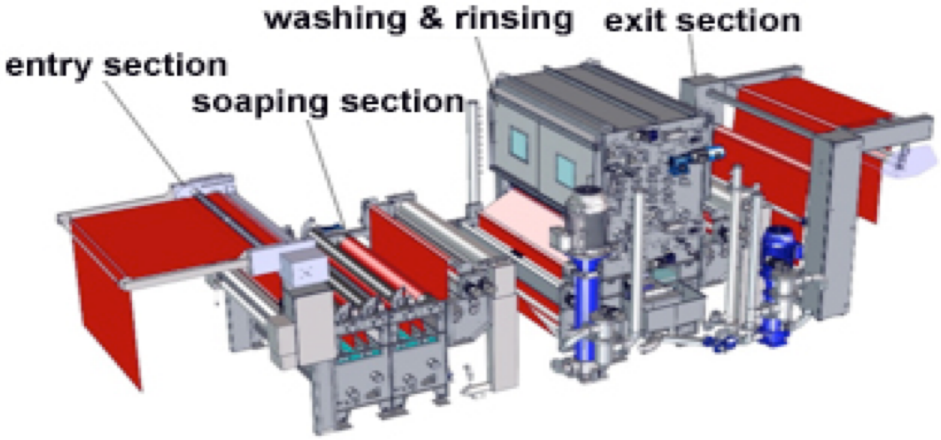


Figure 3 –Kinetika line modules

Technical characteristics

The Kinetika belt washing unit is fitted with 16 spraying bars, which are fed by 3 different pumps: two of them are responsible for the 160.000 l/h huge fluid recirculation, which – assuming a fabric speed of 30 m/min – means processing each meter of fabric with 90 litres of fluid; to note that the fluid impact allows a real passage through the fabric.

Such washing fluids are continuously filtered through 2 self-cleaning rotating filters and a pre-filtering belt, whose function is to remove any impurities to prevent nozzles from being obstructed.
Rinsing is carried out by the third pump, which feeds fresh water to the last spraying bars; this water is then collected in the pre-rinsing tank which, thanks to its limited content, is subject to a complete water exchange every 5 minutes, thus ensuring a good cleaning level. The average water consumption is 6.000 l/h.
The standard washing line is able to process at a speed of up to 60 m/min.
The combined load cell and dancing roller sensors placed in different positions ensure a very accurate fabric tension control, thus reducing fabric elongation to remarkably minimum levels.

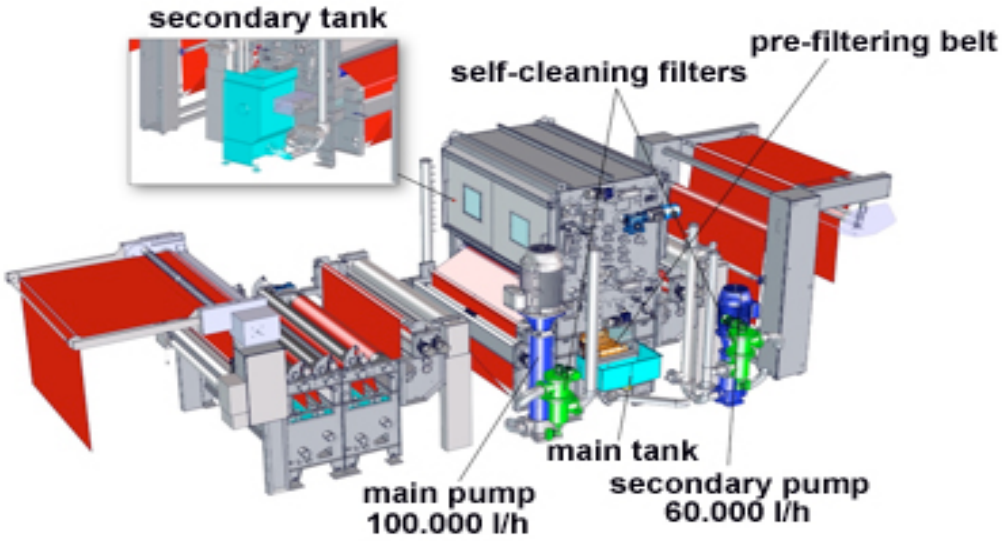


Fig. 4 - pumps, filters and tanks

Washing laboratory test – experimental results

With the aim of measuring Kinetika washing efficiency, several Soxhlet extraction laboratory tests (see fig. 5) have been commissioned, using 3 different solvents (petroleum ether, acetone and ethyl alcohol) .The same fabrics washed with the Kinetika system, have been treated by some end users using traditional continuous open-width washing machines.

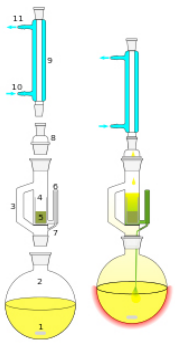
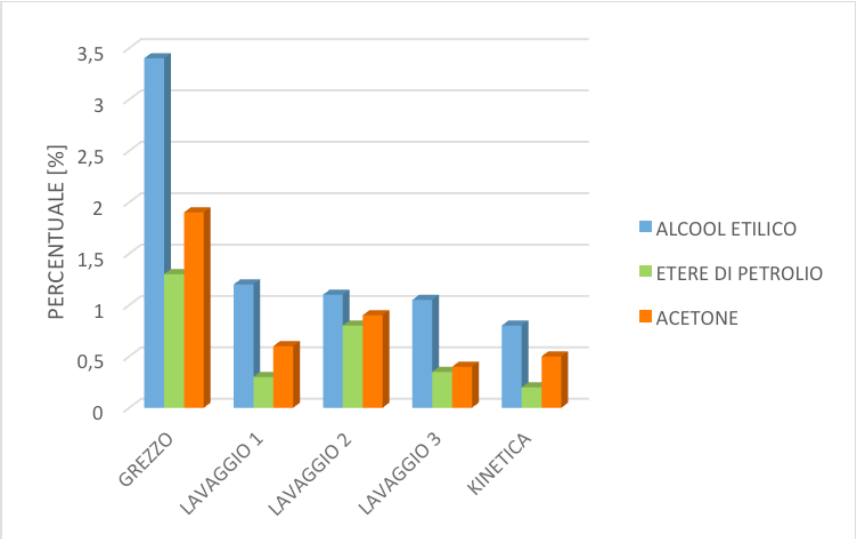


Fig. 5 – Soxhlet extractor

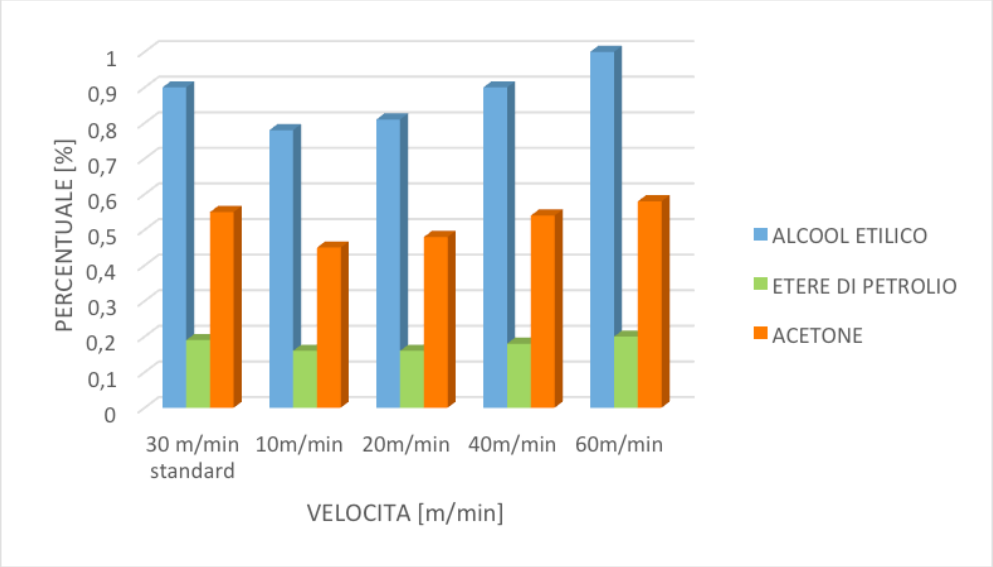
Graphic 6 shows the comparative results, which highlight that Kinetika washing power (by keeping constant fabric speed, soap concentration and fluid temperature) is, on average, slightly higher than the one obtained with traditional 4-5 tank renown machines.



Graphic 6 - Result of extraction tests on different washes

Graphic 7 shows the results of the residual extraction at 4 different speeds, namely 10 m/min, 20 m/min, 40 m/min and 60 m/min: surprisingly, independently of the inversely proportional relationship between the fabric speed and the washing effect, the difference among the 4 speed trials is not so large, which is likely to confirm that the dynamic washing characteristics prevail over the other processing variables.

In this respect, other extraction laboratory trials pointed out that also the soap concentration has little influence on the final washing result.



Graphic 7 - Extraction tests according to speed

Versatility

Kinetika is not only very powerful and efficient, but also a very versatile washing machine: in fact, it's possible to successfully wash very light fabric qualities weighing only 60 gr/linear mt, ladies wear in silk mixes very sensitive to creases formation, thick woollen clothes, elastic fabrics, cotton qualities, technical fabrics in polyester and other synthetic fibres, etc. Indeed, a minimal fabric elongation as well as the absence of any crease marking or selvedge curling has been proven through all trials.

Figure 8 shows a white/grey fabric before and after washing with Kinetika system; to notice width relaxation and shrinkage, and the absence of elongation in warp direction, this is a self-explanatory evidence of Kinetika benefits in terms of gentle fabric handling.

Kinetika can be integrated in traditional lines through a steaming chamber used to fix the fabric (crabbing) and a set of Teflon-coated drying rollers.

Fig. 8 – Fabric dimensions before and after Kinetika washing

Machine dimensions

One of the targets of the Kinetika project was to reduce machine size. The modern continuous open width washing lines are among the bulkiest installations in finishing sector, because the need of a good washing effect combined with higher washing speed demand, determines the need for an increased number of tanks placed one after the other.
With less than 30 metres in length, Kinetika standard lines are very compact thanks to the massive fluid interchange through the fabric (up to 160 cubic metres/h)

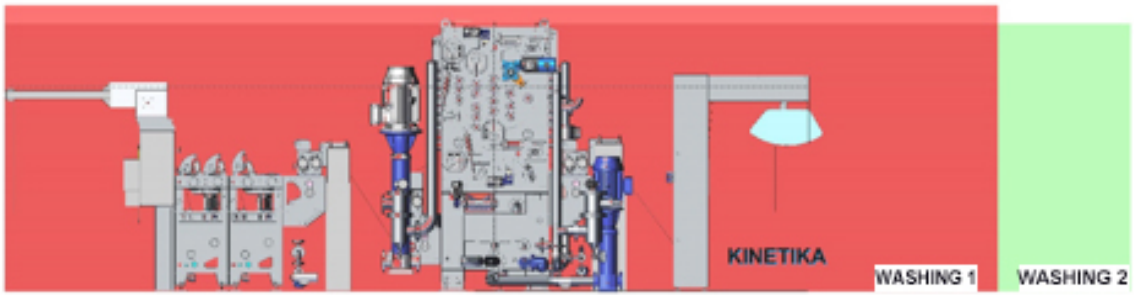


Fig.9 – Dimension comparison between Kinetika and two traditional continuous washing machines