

Ultrasonic cleaning: also for oil tempering line

The request for cleaning processes in the wire industry is continuously increasing along with increased quality requirements. Already largely used for stainless steel and for aluminum wire, ultrasonic cleaning is now also more and more often used in other processes (e.g. oil tempering line, galvanizing lines etc.)

Oil tempering process is commonly used in the wire industry to designate a type of wire which receives a hardening and tempering treatment after it has been drawn to the desired size. The line usually includes:

1. A furnace with tubes having a protective atmosphere
2. An oil quenching bath
3. A tempering furnace (in lead bath or fluidized bed)

Majority of the existing oil tempering lines do not have cleaning bathes at the entrance of the line as this is not absolutely requested by the process. This leads however to some problems. The soaps or oil present on the wires are burning in the furnace and are clogging the tubes. This requires long cleaning operation and frequent replacement of the tubes.

In order to avoid this hard operation, some of the major oil tempered wire producers have now installed a Sirio Wire cleaning line in front of their tube furnace. The pay-back of this technology has been demonstrated. The operation cost of the cleaning line is largely compensated by the savings in tubes and production losses due to tube cleaning and replacement operations.

Ultrasonic cleaning is the use of high frequency sound waves. The activity called cavitation, micro-size bubbles form, grow and implode due to alternating positive and negative pressure waves. Just prior to the bubble implosion, there is a tremendous amount of energy stored inside the bubble itself. The implosion event if it occurs near a hard surface changes the bubble into a jet which travels at a speed of approximately 400km/h towards the hard surface. Because of the inherent small size of the jet, ultrasonic cleaning has the ability to reach into small crevices and removed entrapped soils very effectively.



General view of a Sirio Wire ultrasonic cleaning line

The **basic components** of an ultrasonic cleaning system include some ultrasonic transducers, an electrical generator and a tank containing the cleaning solution.

The ultrasonic generator converts a standard electrical frequency of 50 or 60 Hz into the high frequencies required. The higher the frequency, the smaller the bubbles created during the cavitation will be.

The transducers are constituted of PZT elements (Pb-Zr-Ti) which converts the electrical energy in mechanical vibrations by piezoelectric action. The transducers are installed inside a watertight box made in stainless steel immersed in the cleaning bath and located some centimeters below the wire field. A watertight cable connects the transducer holding box to the generator.

The working **temperature** has a profound effect on ultrasonic cleaning effectiveness. In general higher temperatures will result in higher cavitation intensity and better cleaning. However, if the solution temperature too closely approaches the boiling point of the solution, the liquid will boil in the negative pressure areas of the sound waves, reducing or eliminating the cavitation effect. We are usually working around 60°C (140°F) which offers an excellent compromise.

For the construction materials, Sirio Wire recommends that the bathes be made of polypropylene with one reservoir and one overflow bath in order to avoid any inflexion of the wire. One vertical pump transfers the solution from the reservoir to the overflow bath. In order to avoid any down time, we propose that a standby pump be installed.



View of an ultrasonic cleaning bath, drop trap and air wiping

After the cleaning operation, it is necessary to thoroughly rinse the wire in order to remove the chemical residuals. Sirio Wire has developed a special system working with water under pressure allowing the best rinsing effect.

All Sirio Wire equipment are fitted with special mechanical drop trap and very effective air wiping devices to limit to the minimum the liquid drag out.



View of the drop trap, air wiping and rinsing device

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