

Alternative Quenching System for Steel Wire Production

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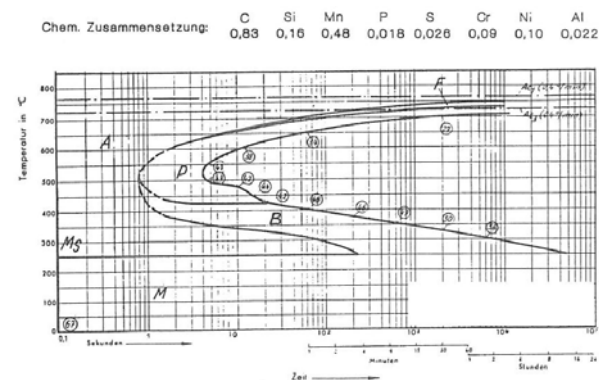
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A newly developed quenching system for steel wire production is introduced as an alternative to lead and fluidized bed systems.

The patenting section in a steel wire plant is the basis for a good quality product. Patenting is the combination of heating, cooling and maintaining a definite temperature level over time. Within this sequence, quenching is the most critical period. The quenching process determines the mechanical properties of the product. These properties must not vary within a narrow tolerance band during production.

The objective of patenting is to avoid the hard martensite structure and to achieve a ductile pearlite one. The isothermal Time-Temperature-Transformation diagram shows that it is therefore necessary to cool the wire from austenitisation temperature very fast to ~550°C and then keep this temperature for a few seconds.

Traditionally, the quenching systems used in the steel wire industry are lead baths. In a technical point of view these systems are very well suited for achieving the desired thermal procedure. But there exist disadvantages which must not be neglected. On top, of course, lead is an environmental poison. These systems are expected to be banned in the future, and for new installations today there already exist a lot of environmental restrictions and directions. Additionally, residues of lead will always adhere to the wire which might require additional chemical cleaning, another critical process. Finally, heating up and keeping tons of lead at high temperature is not for free but requires valuable energy.



Isothermal TTT diagram for steel cord material.

Although shapes and ranges of the individual structures vary with carbon and alloying elements contents, it is a fact that there exists a rather narrow temperature range for the desired pearlite transformation.

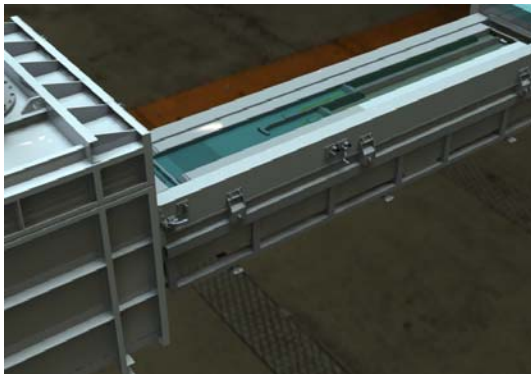
With respect to a stable high quality wire production the quenching system must consequently be capable of accurately adjusting the quenching effect according to the product, especially regarding production speed and wire diameter. The quenching must be controllable and reproducible.

As an alternative to lead baths fluidized bed systems have been introduced to the field. These systems make use of small solid particles impacting on the wire which extract heat from the product by direct contact. Compared to the lead baths these systems are environmentally acceptable and have less power consumption. Still, these systems have some disadvantages. They usually are operated with sand of 100µm to 200µm particle size (with portions below and above). This is a size where dusts can enter the respiratory system and lead to irritations. Particle sizes below approx. 5µm which may be produced during operation due to abrasion and fragmentation even reach the lung and may cause severe health problems. In a technical point of view these systems only allow to run a very narrow dimension range of wires at the same time, since it is not possible to adjust the bed corresponding to the wires individually.

To overcome the above described problems CPA developed a water based quenching system. The quenching fluid is a mixture of water and organic polymers. These fluids are environmentally friendly and easy to handle.

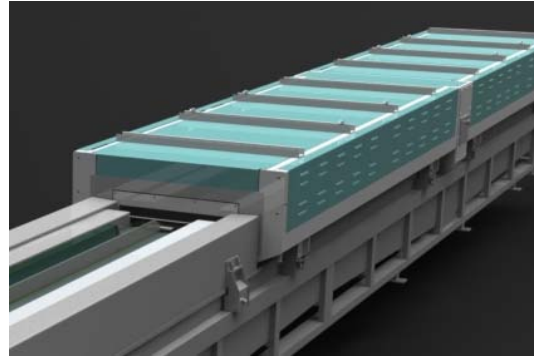
Because of the polymer properties the vapour film phase at the beginning of the quenching is very stable. Due to the comparably long lasting vapour film phase the quenching process is very well controllable. Cooling down to the transformation temperature is finished before the uncontrollable boiling phase starts.

The CPA Convection Film Cooling and Soaking system (patent pending) is designed to run different wire dimensions at the same time. For that reason the cooling section is divided into n individually adjustable sections according to the customer's request. The adjustment is done from outside the tank, no manipulation at running wires or in the quenchant is required.



Two adjustable sections (pat. pend.).

The quenching section is directly connected to the soaking zone without leading the wires through surrounding atmosphere. The soaking zone consists of two in temperature individually adjustable, electrically heated sections. In that way it is possible to introduce a temperature gradient from the entrance to the exit in order to minimise wire temperature changes during the pearlite transformation.



Soaking zone (pat. pend.).

CPA Wire Technologies GmbH is a leading supplier to the steel cord industry and market and technology leader in the field of brass plating, the core technology in the steel cord production. CPA – Technologies for Excellence