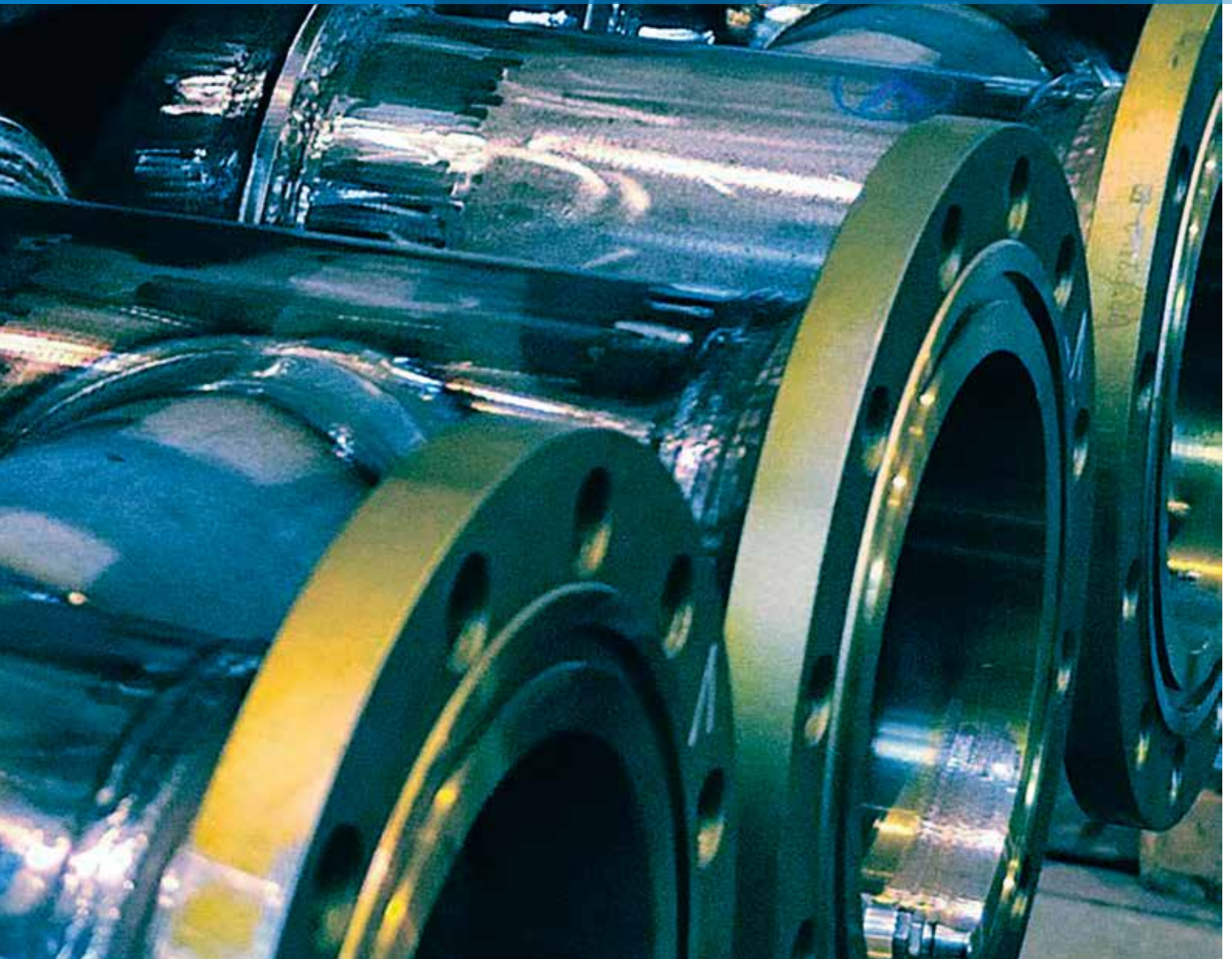


BORSIG

BORSIG
PROCESS HEAT
EXCHANGER
GMBH

SCRAPED SURFACE EXCHANGERS



ABOUT BORSIG PROCESS HEAT EXCHANGER GMBH

BORSIG Process Heat Exchanger GmbH, a member of the BORSIG Group, is the international leading manufacturer of pressure vessels and heat exchangers for cooling gases at very high temperatures (up to 1,500 °C) and high pressure (up to 35,000 kPa) for the chemical and petrochemical industries. These pressure vessels and heat exchangers are used for process stages in plants for the production of basic chemicals where they are installed directly at the downstream end of the cracking furnaces and/or reactors. BORSIG technology is also used in innovative coal gasification processes.

Our comprehensive know-how is based on more than 180 years of company history. The resulting competence, the perfectly trained specialists and our awareness of quality are the basis for the reliability of our products. This symbiosis is the source of our innovative power which is reflected by our unique manufacturing program.

State-of-the-art technology, excellent employees and innovative engineering allow us to always offer our customers the perfect solution. Our products and our service have made and still make us a competent and reliable partner to numerous companies across the world.

Our product range:

- Waste heat recovery systems (ammonia plants, methanol plants, hydrogen plants, coal gasification plants, gas-to-liquid plants, nitric acid plants, caprolactam plants, formaldehyde plants, partial oxidation of oil and gas)
- Transfer line exchangers in ethylene plants
- Scraped surface exchangers for lube oil plants and special applications

BORSIG tunneflow quencher (TLE) for ethylene cracking furnaces



BORSIG linear quencher (BLQ) for ethylene cracking furnaces



SCRAPED SURFACE EXCHANGERS

Since 1928 BORSIG has manufactured scraped surface exchangers. An up-to-date, tailored-to-practice design, modern manufacturing and testing methods and the special know-how of our personnel ensure a high-quality exchanger to meet all requirements with regard to stability, operational reliability and service life.

Shipping of the scraped surface exchangers is done mostly in assembled condition. Thus, the amount of field labour required for installation is minimized.

The applications of the scraped surface exchanger range from dewaxing of lube oil, crystallization of paraxylene, de-oiling of wax, fatty acid service, producing of cellulose acetate flakes, continuous mixing of liquid and semi-solid products under cooling or heating, heat transfer at major fouling of the transfer surface by the product and heat transfer at high viscosity of the product.

We supply scraped surface exchangers for each required volume flow and thermal capacity of inner pipe dimensions of 6 inch, 8 inch, 10 inch, 12 inch and any other special size, which might be required.



BORSIG scraped surface exchanger in the workshop

BORSIG process gas waste heat boiler



BORSIG scraped surface exchanger ready for shipment



APPLICATION

Continuous crystallizing of product components

The separation of components of a liquid mixture by crystallization is a field in which scraped surface exchangers are frequently applied, for example for lube oil dewaxing. The crystals which mainly build up on the pipe wall during cooling are scraped off by the scraper blades of the continuously rotating scraper shaft, propelled to the cooler outlet by the product stream and leaving the scraped surface exchanger being separated by revolving filters or centrifuges. Moreover, the scraper shaft with its fixed scraper blades provides an additional movement of the product and thus promotes the heat transfer. The low temperatures required for crystallization are obtained with a refrigeration system by direct evaporation of a refrigerant in the jacket space of the scraped surface exchanger double-pipe element. BORSIG can thereby rely on its special experience in refrigeration systems.

Heat transfer at severe fouling of the exchange surface by the product to be treated or heat transfer at high viscosity of the product to be treated

High viscosity products or such causing fouling of the transfer surface either cannot be treated or only be treated uneconomically in conventional heat exchangers. Due to their high viscosity and tendency to cause fouling or incrustation, these products form an adhesive film on the transfer surface which considerably impairs the heat transfer between product and cooling or heating medium. By means of the springload scraper blades this film is constantly removed, thus ensuring uniform and efficient heat transfer and low pressure drop.

Continuous mixing of liquid and semi-fluid products while cooling or heating

Scraped surface exchangers are specifically suitable for all continuous mixing processes. Intensive mixing together with favourable heat transfer is guaranteed.

Scraped surface exchanger at plant site



Spider supports for acetylacetat service



The BORSIG scraped surface exchangers are designed and built for an optimum solution with regard to the intended application. For solving these problems BORSIG disposes of a modern data processing center. We are always prepared to assist you with our advice, even in the planning stage.

We supply scraped surface exchangers up to the largest units, for any desired flow rate and thermal efficiency with the inner pipe sizes 6", 8", 10" or 12". Other sizes are available upon request.

Design and calculation can be based on the national standards applicable at the place of installation. Due to the special design of our scraped surface exchangers the maintenance intervals could be extended to 50,000 hours. Furthermore, relubrication of the antifriction bearings is not required within this period.

Scraped surface exchangers are provided for outdoor installation and therefore do not require a special building for protection against atmospheric influences.

Scraped surface exchangers with direct evaporation of a refrigerant in the jacket space of the double-pipe elements can be supplied as cascade, thermosyphon or forced circulation systems, permitting the utilization of all types of refrigerants commonly used.

Prior to leaving our works, each scraped surface exchanger is subjected to a mechanical test run at operating pressure.

The instructions required for proper installation, startup, servicing and maintenance are set forth in an operating manual which will be supplied for each scraped surface exchanger.

Scraped surface exchanger at plant site



Gear motors for drive system

BORSIG drive system



DESIGN - DRIVE SYSTEM

The basic design of the scraper shaft drive is shown on the picture page 6. Excellent lubrication of the heavy duty roller chain is assured by an oil splash lubrication system arranged in the bottom part of the drive housing, which prolongs the chain service life.

In order to avoid fouling of the oil bath and for reasons of accident prevention the chain drive is enclosed in an oil- and dusttight housing.

Easy access is provided by a two-part oiltight door which can be opened or closed by means of a snap closure. A tightening pinion arranged in the idle end of the chain permits manual adjustment of the chain which may have elongated during operation. The movement of the roller chain is transmitted to the scraper shaft by means of the standard drive unit. This standard drive unit has to take up the considerable radial load due to the pulling force and on the other hand it must provide sufficient strength for fixing the sprocket wheel and the shaft in axial direction.

The BORSIG drive unit meets these requirements in an excellent way with regard to quick and easy maintenance.



Sprocket wheels, chain, tensioner

Touch protection, rotation sensor



Scraped surface exchanger for fatty acid service

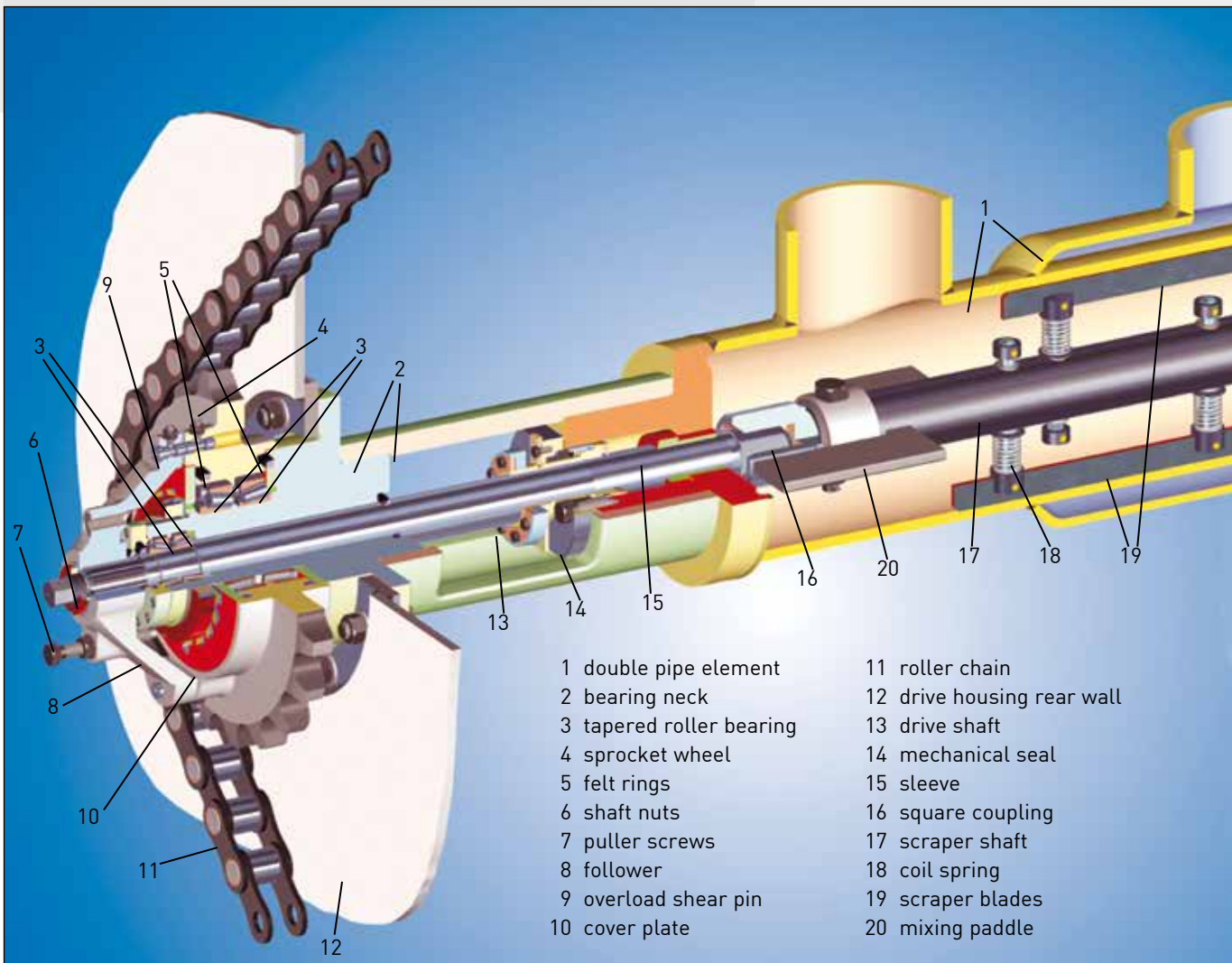


Advantages of the BORSIG drive system

- The sprocket wheel is supported by a fixed bearing neck which takes up the radial load caused by the chain pulling force. A critical alternating bending stress on the drive shaft is prevented.
- Owing to absence of radial load on the drive shaft a considerable improvement of the drive shaft seal is obtained.
- Bearing service life over 100,000 operating hours.
- Maintenance intervals more than six (6) years.
- Gear housing for outdoor installation completely water- and dust-tight.
- In case of shear pin failure, sprocket wheel still rotates on main tapered roller bearings.
- Removal of drive shaft, bearings and drive shaft seal is possible without dismantling of chain drive.
- Superior design for applying mechanical seal.



Scraped surface exchanger in our works



DESIGN - SCRAPER SHAFT

The scraper shaft consists of a multi-part pipe to which the scraper blades are flexibly secured. The interconnection of the individual shaft elements, each about 3m long, is effected by way of a disconnectable pin joint simultaneously serving as support.

A spider bearing body designed to offer low flow resistance carries the bearing bushing. Turning of the bearing body is reliably prevented by a wedge arranged between jacket pipe and bearing body.

The operating experience gained with our scraper shafts in 6", 8", 10" and 12" pipes has shown that this design offers many advantages compared with other systems.

The BORSIG design offers

- Stream-lined design specially with 10" and 12" units (no intermediate pipe etc.) guarantees low pressure drop due to low flow resistance and less product deposition both resulting in longer running time of the units.
- Rugged scraper shaft design.
- Connection of each scraper shaft section with two solid bolts.
- Self locking spider supports, not rotating with the shaft.
- Spider bearing journals and drive shafts are hardened (i.e. with Colmonoy 6 or Wolfram Carbide).
- Support bearing bushes and drive shaft bushes are made of i.e. Bronze, Stellite 6 or Peek.



Installation of scraper shaft

Assembled scraper shaft for acetylacetat service



Assembled scraper shaft with spider support



DESIGN - SCRAPER SHAFT HOLDER

The scraper blade holder has to fulfil two main functions: The scraper blade must be pressed against the pipe wall for efficient scraping and the scraper blade must be kept in position during turning of the scraper shaft.

The BORSIG scraper blade holder is designed as coil spring/ plunger type, which incorporates the two required functions separately.

The peripheral scraping forces during rotating of the scraper shaft are taken up by very rugged and solid plunger rods, holding the blade in a slot and which can radially move in a stainless steel sleeve inserted and fixed across the shaft tube.

The contact pressure of the scraper blades is provided by coil springs on the plungers, which press the plunger rods and thereby the blades to the pipe wall. The coil springs have a flat spring characteristic and are designed to get an optimum result with regard to blade wear and heat transfer performance.

The BORSIG design offers:

- Plunger head design of the scraper blade holders.
- Independent holders for each scraper blade.
- Solid plunger (one-piece design), therefore insensitive to overloading.
- Coil springs effecting self-centring of the shafts thus reducing the load on the bearings.
- Corrosion resistant Monel K500 springs.
- No loose blades in the inner pipe should a spring brakes, blade is still held in position by the holder.
- Low wear of scraper blade due to optimum spring force.
- High blade/spring lift resulting in long service life of scraper blades.
- Damaging of inner pipe is excluded due to special scraper shaft design, i.e. stopping ring at the plunger prevents plunger head touch of inner pipe when blade is worn.
- Scraper blade material is mild steel, brass, fibreglass or other material dependant on the product.
- Running of the shaft in opposite direction presents no risk of breakage for springs and holders.



Installed scraper shaft

Spider support for lube oil dewaxing service



UPGRADING OF SCRAPED SURFACE EXCHANGERS

Experience has shown that scraped surface exchangers in old existing plants give frequent trouble, thus resulting in unscheduled outage and high maintenance costs. The cause of the trouble is in most cases the fact that the drive system and the scraper shafts are worn down and/or the design itself does not have the required levels of reliability and ruggedness for the application involved.

Below are some typical problems with old scraped surface exchangers:

The scraper shafts

- *Reduced heat transfer*
- *Broken springs and/or scraper blades*
- *Wear of plain bearings*

The drive

- *Frequent ruptures of shear pins*
- *Severe wear of the chain wheels*
- *Damage to the bearings*
- *Ruptured drive shafts*
- *Severe leakage of the drive shaft sealing system*

BORSIG can solve these problems by supplying complete drive systems including new scraper shafts which fit exactly into existing scraped surface exchangers of various manufacturers thus adapting them to the BORSIG design. With this adaption to our well proven and patented drive and scraper shaft system our customer will be capable of considerably improving the mechanically reliability as well as reducing the maintenance costs.



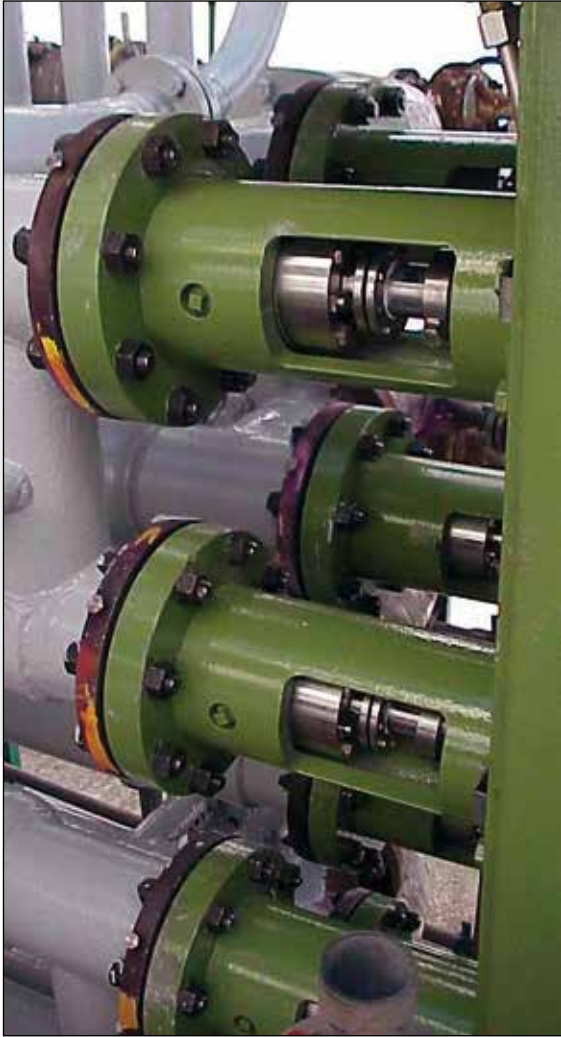
Replacement drive system

Replacement scraper shaft for paraxylene service



New BORSIG drive / old drive





Mechanical seals in replacement drive system

After changing over to this modern and updated design the existing scraped surface exchangers will give guaranteed troublefree operation for a long time.

An improved heat transfer rate can also be achieved with new scraper shafts.

Replacing the scraper shaft

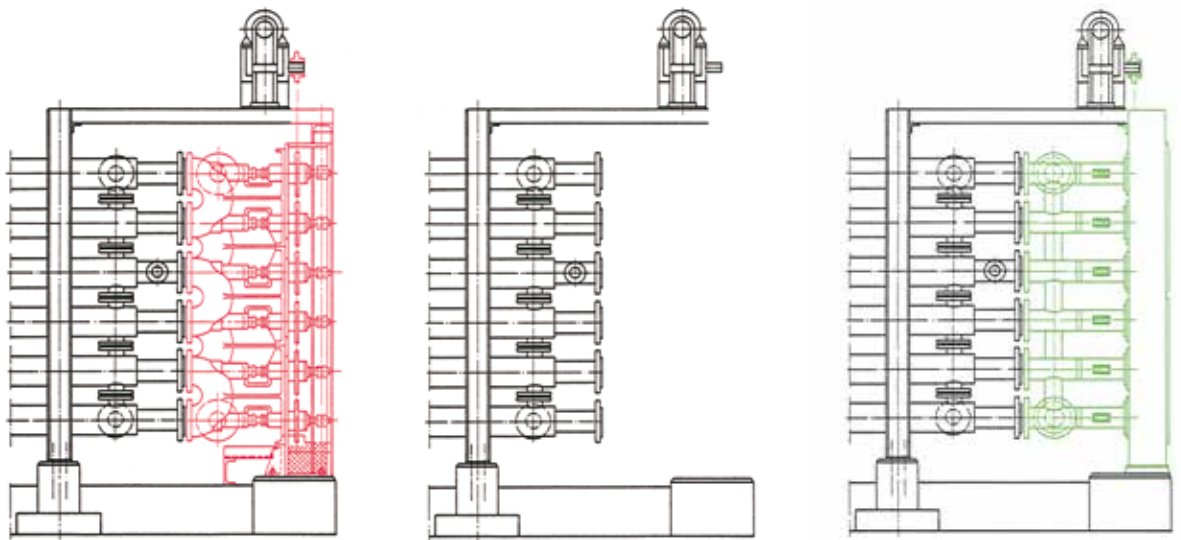
Replacing of the scraper shafts is quite simple and is done from the rear end of the scraped surface exchanger once the blank flanges or return bends have been removed. The replacing can be carried out in max. 2 days.

Replacing the drive

Replacing the complete drive is possible in about 4 days without any plant shut down. Merely the scraped surface exchanger to be converted needs to be disconnected from the train.

Conversion is possible at the site without removing the scraped surface exchanger from its foundation. No welding work needs to be carried out at plantsite. The existing gear motor can be reused. The figures on this page show how the complete drive system is replaced.

Replacement of BORSIG drive system



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