

PUMPS FOR
CONCENTRATED
SOLAR POWER

INNOVATIVE SOLAR THERMAL POWER PLANTS - CLEAN ENERGY WITH RHEINHÜTTE PUMPS

Product innovation and a high level of quality are important components of FRIATEC product development strategy. Our solutions, developed in cooperation with customers, continually set new standards and pioneer new design concepts.

The intelligent energy mix with regenerative energy sources will play a decisive role in the future, securing our global energy needs. Fossil energy generators and atomic power as base load providers will be complemented to an increasing degree in the near future by regenerative energy on an industrial scale. Depending on the geographic location, regenerative energies derived from wind, water, geothermal and solar energy will provide the base load supply of the future.

Solar power generation in the Earth's Sun Belt will, in conjunction with regenerative energies, represent the most important energy source – as life on Earth without the sun is unthinkable. Daily levels of sunlight exceed the annual energy consumption of the entire human race.

This infinite supply of solar energy can only be effectively exploited through the continuous optimisation of large-scale solar power plants. The key to high-efficiency solar power plants lies in the efficient thermal distribution of solar energy and its storage in thermal energy storage systems (TES). High temperatures and innovative thermal storage concepts already enable the realisation of efficient Concentrating Solar

Power (CSP) plants in the 100 MW range today. Next-generation power plants will be capable of providing greater than 250 MW per plant.

TES systems utilising extremely hot molten salt, form the core element of CSP stations. Heat exchangers transmit the energy to the downstream conventional steam turbine process. Solar thermal power plants embodying the highest efficiency potential are represented by the power tower concept with a central focal point and heliostat field, along with extensive collector power plants with decentralised collector fields (parabolic trough or linear Fresnel collectors).

Only reliable, robust and proven supply pump technology in TES systems can sustain this hot molten salt cycle on a planned level – even when the sun is not shining. Inexpensive power generating costs assured by availability not dependent on daylight will also help to cover rising future base and peak load supplies. A solar thermal power plant can supply more than 200,000 people with environmentally-friendly power while simultaneously achieving CO₂ economies of over 150,000 tonnes per annum.



Small pictures 1 and 2 by courtesy of Solar Millenium AG

SUCCESS IS BORN OF EXPERIENCE



As a pump manufacturer with products in demand on a global level and a history of over 150 years, the FRIATEC AG - Rheinhütte Pumps Division has developed to become a specialist provider for sophisticated pumping applications in the market.

With our comprehensive knowledge of materials and designs, we play a prominent role in international competition for engineered pumping system solutions. Our specialised know-how in corrosion and wear-resistant materials enables us to provide our customers with unique individual solutions for specific processes and media.

Open at all times to new challenges, we continually exploit new and innovative application areas. FRIATEC draws on the experience we have gained in the last 50 years in the areas of industrial molten salt applications and sulphur recovery systems, and apply these in the promising CSP market.

The success of high-efficiency solar thermal CSP plants depends greatly on tailored plant components in the TES system. Innovative and reliable pump technology combined with leading material know-how ensures a high degree of safety, greater maintenance efficiencies and long-term plant availability. Product innovation and a high level of quality

represent a considerable success factor for our customers. We already have experience in the manufacture of extremely long vertical pumps. For example, a 17 meter long vertical pump has been conveying hot liquid sulphur for several years now in a loading terminal of a sulphuric acid plant.

Rheinhütte pumps have been employed with success in several test systems in new solar thermal power plants. A further project is the design, production and installation of TES salt circulating pumps for the Andasol III solar thermal power plant in Spain.

With regard to our tailored solutions for pumping molten salt, we set new standards through cooperation with our customers in on-site discussions as we continuously endeavour to find and exploit new options. Working together with our customers from the beginning of the project we are able to insure the success and potential of TES systems with our vertical salt circulating pumps.



SOLAR THERMAL POWER PLANTS



Technical know-how is essential in the area of special material combinations for high-temperature applications in TES systems for CSP plants. Eutectic molten salt mixtures at temperatures exceeding 500 °C consisting of sodium nitrate (NaNO_3) and potassium nitrate (KNO_3) therefore require reliable pump concepts.

The greatest commercial significance of CSP plants lies in the area of night-time energy availability. TES systems and the downstream conventional secondary steam turbine process are comparable, regardless of the CSP plant type involved. Our tailored vertical pump solutions enable our customers to attain a maximum level of flexibility. The balanced ratio between hydraulic efficiency and a simultaneously low space requirement results in one of the best controllable pump concepts for TES systems.

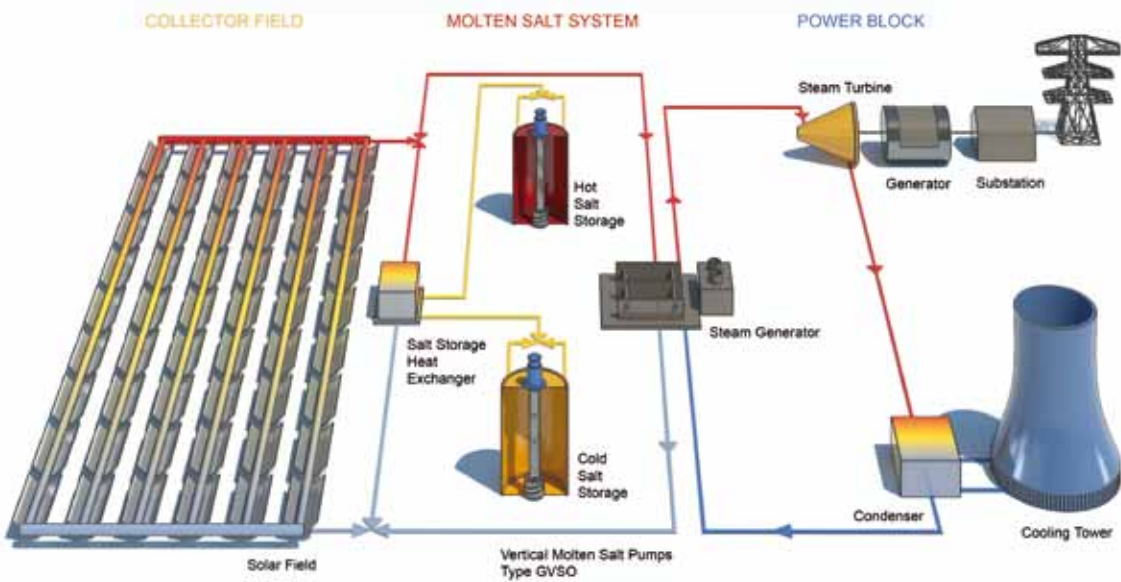
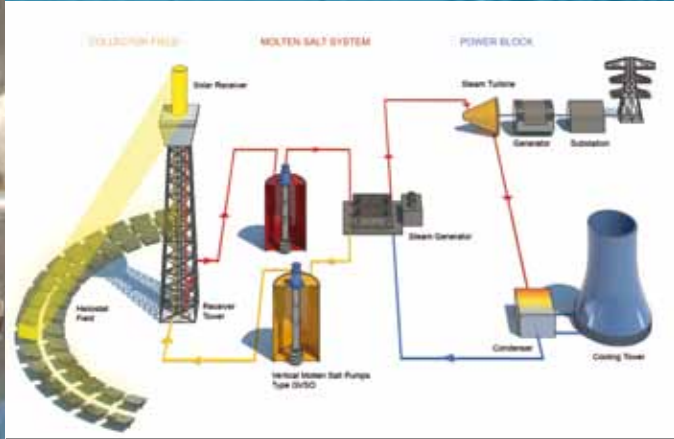
Parabolic trough systems

The characteristic features of these power plant designs are the extensive decentralised collector field with parallel-configured collector columns. The heat carrier material (HTF) is heated within the focal line. Direct and indirect thermal transfer to the TES system is employed, depending on the plant design. Temperature ranges from 200 °C up to greater than 565 °C and large tank dimensions not only demand specialised know-how when it comes to selecting materials, but also special design requirements of these critical supply pumps.

The unique pump design and balanced ratio between size and delivery capacity enable use of pumps for applications ranging from test systems up to large-scale industrial plants.

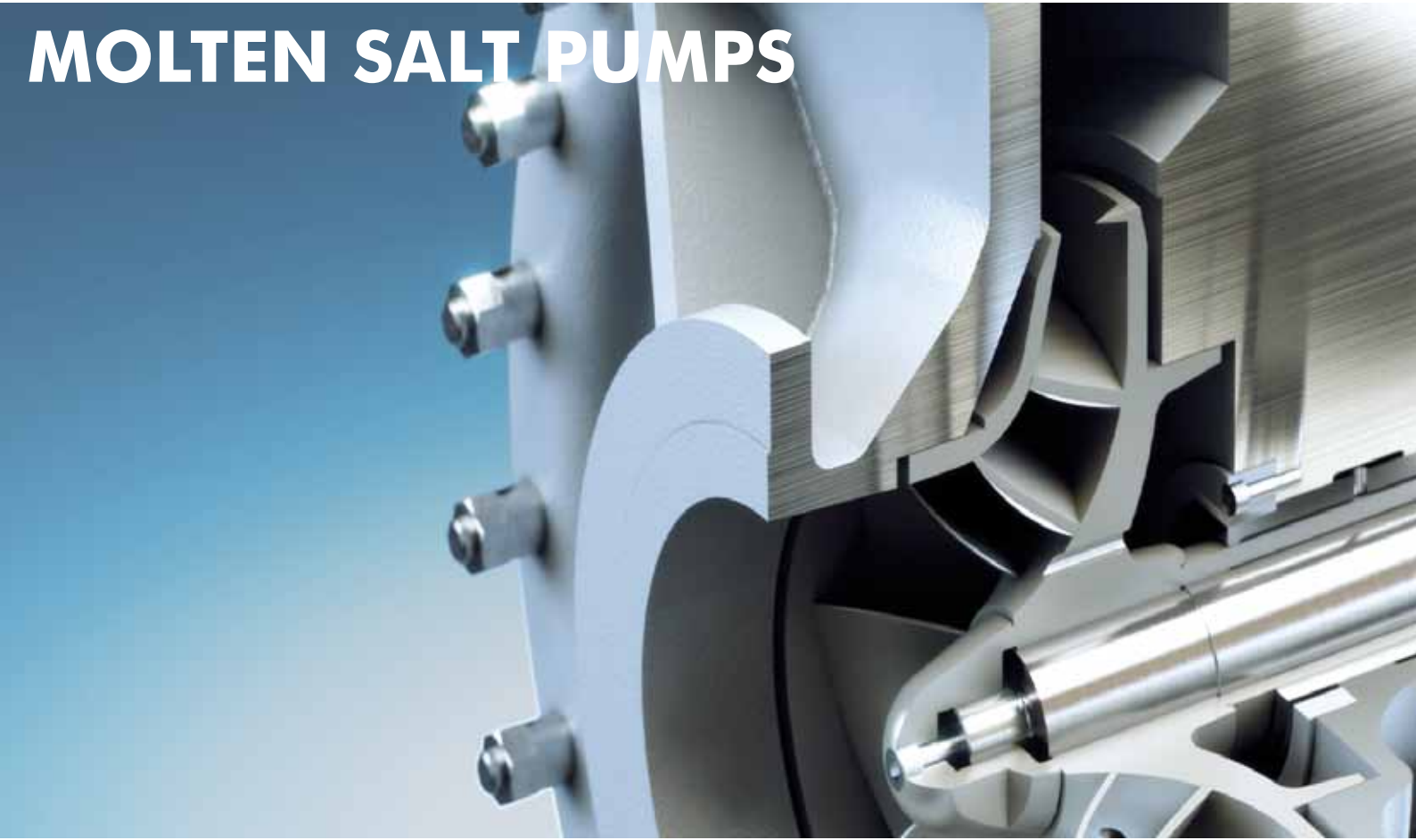
Power tower systems

Power tower systems are distinguished by a central structure: the central receiver tower. Solar energy is collected in a central focal point located at a high altitude on the tower. High-efficiency supply pumps are therefore required for the receiver in the TES system. The convincing performance of our vertical pumps is also demonstrated here through perfectly-coordinated multi-stage hydraulics and the pressure levels achieved. This special design enables the achievement of minimal machine vibrations and fully-variable submersion depth adaptation. Their operation can be fully controlled at all times, even where variable speeds are involved. Our special pump concept thus enables long-term plant availability; high efficiency and delivery pressures and therefore minimal losses are the result.



Main picture by courtesy of paul-langrock.de /Solar Millennium AG
 Small picture 1 by courtesy of Solar Millennium AG

MOLTEN SALT PUMPS



With their special design and innovative details for high-temperature applications, vertical pumps from Rheinhütte have always persuaded users through their long-term availability, corrosion resistance, reliability and quality.

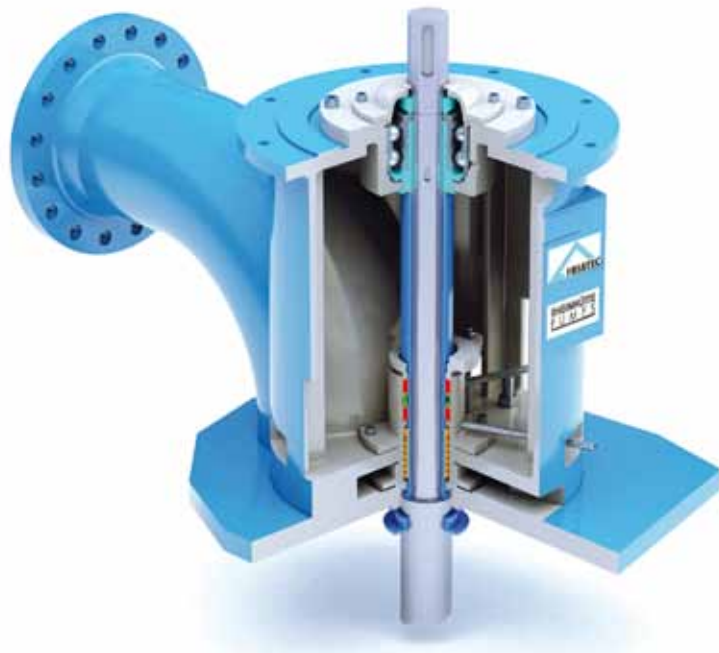
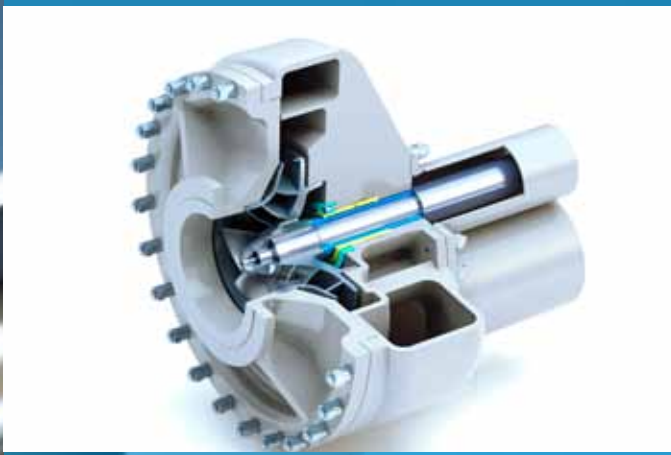
Operating Parameters

- Flows up to 4000 m³/h (17,600 gpm)
- Heads up to 320 m (1,050 ft)
- Pressure rating up to ANSI 900 (PN 64)
- Modular submersion depths from 0.5 m to more than 17.5 m (1.6 ft to 57.4 ft)
- More than 20 different radial hydraulic sizes ideally suitable for single or multi-stage designs
- Discharge flange sizes up to 450 mm (18 in.)

Advantages at a glance

- Compact and simultaneously torsion-resistant machine concept
- Low vibration pump operation, thanks to optimum pump design
- Perfect wear and abrasion minimisation for all modules in contact with fluid, and minimal pressure losses through flow optimisation

- Fully variable speed range for efficient operation
- Thermally optimised pump design with low heat loss to surroundings
- Simply controlled roller bearing lubrication concept without thermal influences
- Reliable operation free of leaks, thanks to a simple shaft sealing concept
- Optimum friction bearing lubrication through spatial separation of pressure-conveying components
- Maintenance friendly machine concept with simple dismantling and inspection options
- Specific temperature and medium material combinations adapted to suit requirements



MONITORING AND DIAGNOSTIC SYSTEMS

To complement our superior product quality with specific customer consulting, we also provide monitoring and diagnostic systems for monitoring and enhancing pump availability. Individual pump monitoring, which can be combined with our intelligent diagnostic system, enables reliable monitoring of the core element of your plant at any time.

Monitoring systems

Our monitoring systems are individually adapted to suit customer requirements. In addition to standard industrial sensors for temperature and vibration acceleration, velocity sensors and rotation direction detectors are also available. Perfectly adapted high-temperature sensors for pressure and temperature measurements round off the array of elements available for status monitoring.

The integrated digital display in the monitoring system even enables on-site control and monitoring of all relevant pump parameters. All sensor signals are calibrated to the industrial standard and the control room provided to enable perfect system integration in existing monitoring and measurement environments.

Diagnostic systems

Intelligent early detection of malfunctions through high dynamic signal evaluation forms the core element of our diagnostic

systems. These versions with optional automatic data-logging enable continuous malfunction detection where limit values are exceeded. The advantage lies in the further enhancing of plant availability and optimum planning of maintenance intervals. Dynamic vibration analysis with specific customer limit value assignment is complemented by the visual warning and alarm function of the integrated light system on the diagnostic unit. The computing and evaluation unit also enables even user-friendlier linking to existing measurement systems using established industrial data-bus standards. All current operating parameters can be called up online at any time. A Windows-based database system is also optionally available for improved logging and administration.

That which applies to our pumps is also standard for our monitoring and diagnostic systems: individual systems tailored to suit individual customer requirements, which can be freely expanded, and distinguish themselves through superior quality and user-friendliness.



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