ENERGY RECOVERY
1.1 THE COMPANY

SCHMIDTSCHEN SCHACK, a division of the ARVOS Group, was formerly ALSTOM Power Energy Recovery GmbH, which was formed through a merger of the two traditional companies Schmidt'sche Heissdampf Gesellschaft mbH, Kassel and Rekuperator Schack GmbH, Düsseldorf in 1995. With headquarters and fabrication facilities in Kassel, Germany, the company also operates a branch office in Düsseldorf and has affiliated units in Wexford PA, USA and Kobe, Japan.

SCHMIDTSCHEN SCHACK is a partner of the world’s leading engineering companies, contractors and operators in the chemical, petrochemical and metallurgical industries.

1.2 PRODUCTS AND SERVICES

SCHMIDTSCHEN SCHACK in Kassel, a pioneer in the field of industrial high-pressure technology and developer of the first superheated steam generator (1910), is today a world leader in process gas cooling systems for the petrochemical and chemical industries and specializes in thermal systems and waste heat steam generation in chemical and petrochemical plants.

At the Düsseldorf, Kobe and Wexford sites, SCHMIDTSCHEN SCHACK has proven competence in high-temperature technology stemming from experience gained since 1931 in the fields of recuperators for industrial high-temperature applications, steam superheaters and fired heaters for process media.

SCHMIDTSCHEN SCHACK is renowned as a developer and fabricator of special apparatuses designed to withstand extreme pressures and temperatures, often combined with additional challenges, e.g. high dust loads or aggressive operating conditions.

Of particular value to customers is SCHMIDTSCHEN SCHACK’s excellent product quality ensured through a single source principle stretching from design, QM/QC to fabrication in SCHMIDTSCHEN SCHACK’s own specialized workshops.

Individual customer support in all phases of a project, even after the plant has come on stream, has a long tradition at SCHMIDTSCHEN SCHACK.

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Kassel & Düsseldorf (Germany), Wexford PA (USA) and Kobe (Japan)
1.3 EXCELLENCE IN DESIGN, RESEARCH & DEVELOPMENT

The development of highly sophisticated heat recovery equipment requires a broad engineering knowledge of underlying physical processes as well as a thorough command of appropriate numerical computing methods. As a global technology leader, SCHMIDTSCHE SCHACK cooperates and interacts closely with leading process developers on the translation of desirable process parameters into physically achievable apparatus solutions.

Experimental investigations and measurements are performed either at SCHMIDTSCHE SCHACK's own laboratories or in cooperation with renowned research institutes. Theoretical models and experimental results are verified though evaluated field measurements conducted in operating plants, forming the basis for improved technical solutions and new products.

Exceptionally experienced R&D teams analyze and handle a wide range of highly intricate challenges related to 3D simulation, process and boiler/fluid dynamics, thermodynamics, chemical and metallurgical reaction kinetics, nonlinear mechanics and vibration theories using the latest calculation software including software developed or further optimized in-house.

Customers benefit from continuous product quality improvements ensuring reliable operation, prolonged lifetime and utmost operational efficiency of SCHMIDTSCHE SCHACK's heat transfer components.

Figure 1: Main office and workshop in Kassel, Germany
1.4 EXCELLENCE IN MANUFACTURING

We are committed to operating our own workshop in order to meet our customers’ and our own quality standards. It forms the reinforcing element between excellence in design, research & development and our customers’ expectations regarding the outstanding performance of our products.

Advanced manufacturing techniques and sophisticated production and testing machinery, combined with highly qualified, annually certified manufacturing personnel, enable the creation of outstanding quality products by

• welding of heat resistant steels, i.e. high chromium and high nickel alloys
• workforce of well trained fitters for the manufacturing of pressure parts with the associated mechanical internals
• completely furnished workshop to perform machining, plasma cutting, welding, heat treatment, blast cleaning, assembling and coating of large and heavy components.

SCHMIDTSCHE SCHACK’s in-house manufacturing operations in Kassel comply with all national standards and specific customer requirements.
1.5 EXCELLENCE IN QUALITY MANAGEMENT

Quality management, in our opinion, means more than simply complying with standards and meeting high customer requirements.

SCHMIDTSCHE SCHACK is certified according to ISO 9001, ASME U, U2, S, PP, R-Stamp, Safety Quality License for the Import of Boiler and Pressure Vessels to the People's Republic of China, Korean Manufacturing License, ISO 14001; OHSAS 18001; “Großer Eignungsnachweis” according to EN 1090-2; DIN EN ISO 3834-2; AD2000 – HPO; PED 97/23/EG Module H+H1 and other national and international standards.

NDT is performed by SCHMIDTSCHE SCHACK personnel and equipment in accordance with EN 473 and SNT-TC-1a, level II and III for the procedures of RT, UT, MT, PT, VT and LT. Quality is controlled from receipt of raw materials, through all individual manufacturing steps, including sub-suppliers, up to final inspection just before the SCHMIDTSCHE SCHACK products leave the workshop.

Final documentation is prepared individually and in accordance with customer requirements.
The double tube/oval header design principle of the Schmidt'sche® Transfer Line Exchangers (TLEs), first developed in 1959, was found to be superior to other designs and has been used ever since.

These Schmidt'sche® TLEs perfectly meet the process requirement to rapidly cool cracked gases. In addition the economical aspect of recovering energy by generating high-pressure steam meets a large portion of the plant’s energy demand. Safety, reliability, low maintenance and highly efficient operation are optimally achieved by this design. Trouble-free operation for over 30 years in some plants proves the reliability of the Schmidt'sche® TLEs. Apart from process gas cooling in ethylene plants, Schmidt'sche® TLEs are also highly valued for syngas cooling in coal gasification plants and in other processes.

2.1 ROUND TYPE

This most frequently used type of multiple tube TLE is characterized by a large number of parallel tubes.

Round multitube TLEs are particularly flexible in feedstock handling.
2.2 LINEAR TYPE
This exchanger concept is closely linked to the development of cracking heaters with short residence time. The special feature of this design is that a single exchanger tube is directly connected to each heater coil outlet. Short gas residence time within the inlet area ensures maximum selectivity of the cracking reaction.

2.3 BATHTUB TYPE
The bathtub TLE has oval-shaped channels so that a number of cracking heater coil outlets can be directly connected. Compared with the Round Type TLE design, the Bathtub TLE offers shorter residence time in the gas inlet chamber and improved coking behaviour.

2.4 QUICK QUENCHER TYPE
This advanced type of multiple tube TLE was jointly developed and patented with ABB Lummus Global, Bloomfield, USA for sophisticated cracking heater technology with short residence time. QQ TLEs combine the advantages of rapid cooling with those of short inlet residence.
The trouble-free, high performance operation of more than 7,000 Schmidt'sche® Transfer Line Exchangers in ethylene plants around the globe encouraged SCHMIDTSCHE SACK to apply the same unique Schmidt'sche® Double Tube/Oval Header Design for Schmidt'sche® Syngas Coolers. This concept is ideally suited to fulfilling the special requirements in gasification processes like fixed bed, fluidized bed or entrained flow.

Convective syngas coolers operate in the temperature range between 1,100 and 400 °C and are designed for gas-side pressure up to 60 bar and steam pressure up to 150 bar. High operation parameters and special operation conditions, such as corrosive raw gas components (H₂S, HCl and H₂) and high dust loads, impose very high requirements on the proper design, material selection, manufacturing and quality control.

The Schmidt'sche® Double Tube Design with Oval Headers is a unique heat management system to cool gases on one side and generate steam on the other. The double tube register consists of a row of double tubes (tube within a tube) which are welded to oval headers at either end.

The process gas flows through the inner tube and is cooled by the water/steam mixture flowing through the oval headers and the annulus between the inner and outer tubes.

A certain number of registers containing different numbers of tubes are combined to form a single exchanger body by welding the adjacent oval headers together to create gas-tight “tube sheets”. This is not a tube sheet in the classical sense, which would need to be refractory lined, nor does it need ferrules for the tube inlets. Funnel-shaped tube inlets together with intensively cooled oval headers have been shown by experience to offer the best protection against tube inlet erosion and the formation of gas-side deposits.

Such double tube steam generators are usually arranged vertically with gas flow from top to bottom and operate in natural circulation mode.
3.1 SCHMIDT’SCHER STEAM SUPERHEATER, BAYONET TYPE

Schmidt’sche® Bayonet Steam Superheaters are employed in SNG units’ methanation stages adjacent to the synthesis gas production, e.g. downstream gasification processes. Hot methanation gas of 600 to 700 °C enters the superheater and heats saturated steam to reach superheated steam condition in excess of 520 °C. The functional principle is a design where the hot methanation gases flow through a pressure vessel whereas the steam superheating takes place in a tube-in-tube arrangement, one side being fixed to the tube sheet.

3.2 SCHMIDT’SCHER STEAM SUPERHEATER, HELIX COIL TYPE

Schmidt’sche® Helix Coil Steam Superheaters are able to operate under high steam-side as well as gas-side pressure. A large number of specially wound tube spirals are interlaced to form compact tube bundles cooling the gas in countercurrent flow in the cross section. The highly flexible high-alloyed tube bundles in spiral shape keep thermal stresses at a minimum and permit high operating temperatures, i.e. 850 °C on the gas side and 560 °C on the steam side.

Even Syngas with high dust loads can be handled. SCHMIDTSCHER SCHACK-developed mechanical cleaning devices are implemented for this purpose.
3.3 SYNTHESIS GAS COOLERS FOR PARTIAL OXIDATION

Synthesis gas coolers downstream of partial oxidation reactions like coal, heavy residual oils, biomass, hydrocarbon substances, etc. make high demands on engineering, design and fabrication skills. There is an ongoing trend towards higher pressures and temperatures on the synthesis gas side of the steam generators, i.e. up to 100 bar gas pressure and 1,800 °C gas temperature.

Schack® Syngas Coolers have proven their reliable operation even in aggressive atmospheres without being affected by the metal dusting phenomenon or high-temperature H₂S corrosion.

Figure 8: Reactor and heat exchanger of a large scale partial oxidation plant
3.4 PROCESS AND FLUE GAS COOLING SYSTEMS FOR REFORMER PLANTS

Schmidt’sche® Process Gas Cooling Systems downstream of reformers consist of:

- Schmidt’sche® Process Gas Coolers, characterized by
  - thin flexible tube sheets to minimize tube-to-tube sheet weld stresses
  - alternatively, special SCHMIDTSCHE SCHACK “SUPLEX” tube sheets for extreme process conditions
  - full penetration tube-to-tube sheet welds for crevic corrosion-free tube-to-tube sheet connection
  - ceramic or alternatively metal
  - “SCHMIDTSCHE SCHACK Cold Bypass” to avoid metal dusting corrosion
  - steam drum with internals for excellent steam quality

- HP Steam Superheaters

- Synloop Waste Heat Boilers in synthesis gas streams of ammonia plants

- Flue Gas Convection Systems downstream of reformers

3.5 PROCESS GAS COOLERS DOWNSTREAM OF AMMONIA COMBUSTION FOR NITRIC ACID/CAPROLACTAM PLANTS

SCHMIDTSCHE SCHACK designs and fabricates Heat Recovery Steam Generators downstream of catalytic oxidation processes in nitric acid and caprolactam plants, custom-made and optimized for the production process and up to world-scale plant sizes. SCHMIDTSCHE SCHACK’s advanced control evaporator technology allows the process operator to adjust the gas outlet temperature over the full load range.
4.1 SCHACK® CONVECTION RECUPERATORS IN DRI PLANT

The use of SCHACK® Heat Recovery Systems for heat management in DRI plants is key to improving the economic efficiency and profitability of the DR process. SCHMIDTSCHIE SCHACK supplies heat recovery systems including convection recuperators based on the proven Schack® design for all state-of-the-art DR processes. Proprietary design, high-quality dedicated manufacturing and maintenance of heat recovery systems for integrated reformers at operating temperatures up to 1,100 °C belong to the core competences of SCHMIDTSCHIE SCHACK.

4.2 SCHACK® SHELL & TUBE RECUPERATORS

This design was developed for the cooling of dust-laden gases in various processes with temperatures of up to 1,100 °C.

Energy is recovered by heating process air or process gas for the purpose of saving fuel and increasing yield. Preheat temperatures of 900 °C and higher are possible.

Applications: Carbon black, limestone, sludge incineration and in chemical and petrochemical processes.
4.3 RADIATION RECUPERATORS

The typical Schack® Double Shell Recuperator is ideally suited to high-temperature, dust-laden flue gases with corrosive constituents. It consists of two concentric steel cylinders. The flue gas flows through the inner cylinder, while the air is led through the narrow annular gap.

This design has proven successful behind furnaces in steel mills, forging, glass and aluminium melting processes and in refuse and sludge incineration plants. Schack® Tube Cage Radiation Recuperators are often used in the glass and chemical industries to preheat large air quantities to high temperatures.

4.4 FIRED HEATERS

Schack® Fired Heaters are technologically leading in heating/evaporating steam, sulphur, hydrocarbons, oil, water/glycol mixtures, natural gas, hydrogen, oxygen, helium and air. The special Schack® design enables utmost operational efficiency and thus supreme economy.
4.5 SLUDGE INCINERATION

Schack® FGTT Type Recuperators incorporate a design whereby hot flue gas flows through the tubes (FGTT), and the heated medium air flows over the tubes in multiple cross-counterflow passes. Schack® FGTTs have wide acceptance in fluid bed and other dirty gas applications due to their self-cleaning, erosion resistance and long lasting design. Our proprietary inter-stage bypass enables tighter control over the air preheat under varying furnace loads. Air preheats typically range from 540 °C – 700 °C (1,000 °F – 1,300 °F).

Schack® Green Boilers recover waste heat from flue gases downstream of incinicators. Sizes typically range from 2 to 20 t/h of steam (5,000 to 50,000 lb/hr) at 4 to 40 bar (60 to 600 psi). The boilers may be of the water-tube design (high pressure) or fire-tube design (low pressure). Vertical gas flow arrangement consumes very little plot space and allows for installation of ash hoppers. Water-tube boilers can be fitted with online cleaning devices, while the fire-tube version acts as a self-cleaning design.

4.6 ADVANCED SYSTEMS

As a highly innovative enterprise, SCHMIDTSCHWE SCHACK develops new solutions in technology with process owners and calculates, designs and fabricates the components. Special application products include reactors for fluidized bed methanation plants, mobile steam flooding systems for oilfield use, high-temperature steam superheaters, direct fired helium heaters, inter-stage heaters for styrene plants, reaction gas heating systems, raw gas coolers and other components for coal gasification processes.