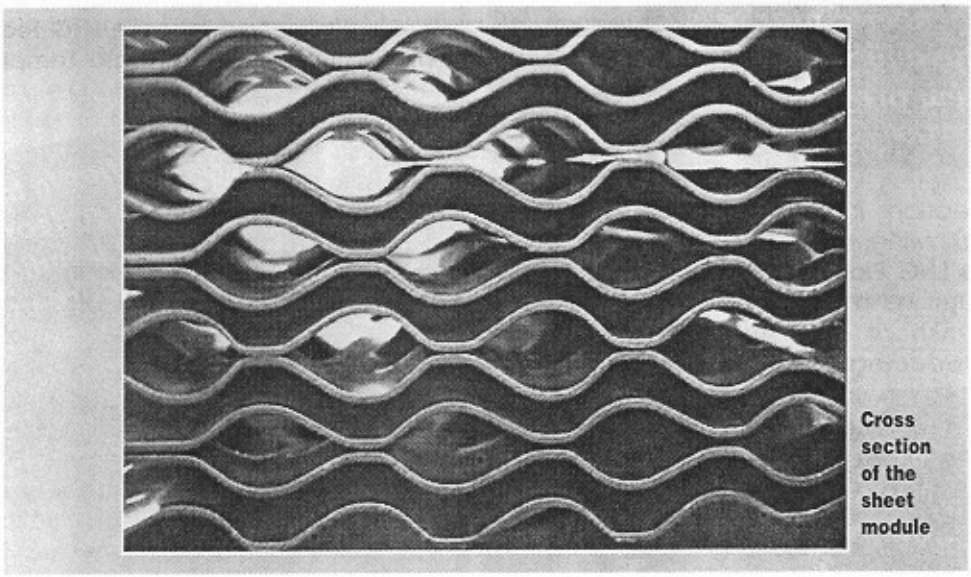
# A new generation of heat exchanger systems

*Heat transmission is important for almost all operational processes. The use of heat exchangers is necessary for heating, cooling and evaporation of fluids. Lately, the saving of expensive primary energy, using exhaust heat, has justified the use of heat exchangers. Previously in most cases, tube or plate heat exchangers were used. Technical know-how and modern plants are the basis for the latest generation of heat exchanger systems for operational plants.*



**Cross section of the sheet module**

The fully welded Hybrid Heat Exchanger fills the space between the conventional tube bundle and plate heat exchanger. All systems have their own specific advantages and disadvantages, and the new Hybrid Heat Exchanger combines the temperature and pressure resistance of the tube heat exchanger with the compact and economical design of the plate heat exchanger.

With the flexible design possibilities of the Hybrid System, an optimum solution for any problem with thermal, physical and geometrical requirements is possible. The temperature range of the Hybrid Plate Heat Exchanger usually is from -200°C to +900°C. The operational pressure limit is 60 bar absolute pressure.

Experience with Hybrid Heat Exchangers in use has shown advantages in comparison to shell and tube heat exchangers - the special design of flow channels provides a far better heat transmission for both gases and liquids.

The Hybrid Heat Exchanger is being utilised in all areas of process engineering as a cross streamer or counter cross streamer in closed systems, transmitting heat energy between different media. Heating surface densities of up to 250 $m^2$ transmission surface per $m^3$ structural volume are realisable. Single units may be constructed up to 7000 $m^2$ of heating surface.

## Design of the Hybrid Heat Exchanger

The basis for all designs of the Hybrid Heat Exchanger is a 360 mm wide, shaped plate with a plate thickness of 0.4 mm to 0.8 mm.

Two identically shaped plates form a shape plate element. Nine rectangular flow channels with wavy flow are formed, which provide the plate-sided flow areas. The limitation of the nine separate flow channels is given by cross imprints on which the shaped plates are one on top of another. The wavy flow results in high turbulence and good heat transfer conditions. The Hybrid modules are formed by stacked, shaped plate elements, which are welded at the front side by cross seams. The special stamping forms elliptical tubes in a vertical position to the plate-sided flow channels.

The Hybrid Cut shows that almost all sheet surface is available for heat transfer. Material use is optimised. The possibility of using very thin sheet thickness is not only advantageous for material elimination but also the heat transmission of materials with lower heat conductivity is less affected.

## Wave flow cross-section

The flow geometry results in a wavy gap without dead spots, giving very good heat transfer and minimal pressure loss.

Depending on the plate thickness and stamping die, the pressure range of the wave side is 0 bar up to approximately 60 bar absolute pressure.

It is possible to increase the wave pass correspondingly for mechanised physical cleaning in case of handling fluid with very bad fouling features.

### Tube-sided cross flow section

The flow geometry of the tube side is formed by tube cross sections of 330 mm length flow channels. Regular cross imprints produce stumble corners for the flow and every cross imprint forms a new inflow edge, creating high turbulence in the boundary layer of the flow.

### Production

The fully welded design means absolute isolation of both media, important in case of higher pressures and temperatures, providing important additions in the field of application in comparison to plate heat exchangers, with no costs for spare gaskets.

The side plates are supported by screwed-in tie rods and, if required, provided with supports.

### Individual solutions

With the flexible design possibilities of the Hybrid System, it is possible to solve individual problems quite easily. The dimensions of heat transfer modules are marked by the length of the used shaped plates (plate length) as well as the quantity of stacked, shaped plate elements (pile height). It is possible to arrange several modules, one behind the other, which basically means that the heat transmission block is variable in all three dimensions. Besides the possibility of varying external dimensions, it is possible to fit the geometry of flow channels to respective demands.

The heat exchanger can be used as a pure cross streamer or counter cross streamer. More passes are realisable on the tube-side as well as on the wave-side.

The cross section of the tubes can be altered by varying the stamping depth, ranging from 6 mm to 11 mm. The wavy flow channels can be increased by special lateral stamps.

It is possible to offer heat exchangers for different fields of application but the base material is always an identical dimensioned sheet. The resulting advantages, regarding the production, provide tailor-made solutions at competitive prices.

Features of the Hybrid System include:

- Tube-formed cross flow sections without dead spots. Frequent cross imprints provide an important increase for the heat transfer as stumble corners in the flow without increasing pressure drop. The cross imprints give support between the relating tube cross sections and an important reinforcement of shaped plate modules.
- The heat transfer takes place on the exchange-element wall of between 0.4 mm to 0.8 mm thickness which forms the primary heating surface.
- Use of corrosion resistant materials regardless of heat conductivity, provided it is deformable and weldable.
- It is possible to clean the flow channels by means of water, air and steam jet as well as chemical means.
- Fully welded construction without soldering joints or large surface seal areas.
- Adaptable to different duties by simple subdivision in several flow paths (counter cross flow).
- It is possible to adapt the thermodynamic features of heat exchanger elements in a cost efficient manner by means of stamping tools and different stamping depths.
- A maximum of quality to low cost ratio is guaranteed by automated production of shaped plates and high precision welding.
- It is possible to handle both high temperature and pressure ranges. Pressures range from approximately 60 bar absolute pressure (designed higher pressure is possible).
- Operational temperature ranges between -200°C and +900°C.
- High safety is ensured by non-oscillatory construction and the elastic balance of heat tension.
- By means of standardised elements with fixed widths, any length (to approximately 12 m) and number of plates (to approximately 1500 units per block), it is possible to realise heating surfaces up to 7000 $m^2$.
- Less material is used due to the compact design. The operational weight is reduced (steel substructure). Lower filling media charge (hold-up) is required.
- Lower filling charges and thin wall thickness provide the Hybrid Heat Exchanger with very good and rapid regulation.

Applications range from liquid/liquid, gas/gas to liquid/gas, for evaporation or condensation.

### Conclusion

With the flexible design possibilities of the Hybrid System, an optimum solution to any problem for thermal, physical or geometrical requirements is possible. The design of the heat exchanger is determined by the given general conditions, by means of experienced EDV programmes. Physical data for a multitude of materials are retrievable from it.

Light, optimally dimensioned and economical heat exchangers are brought to the market by producing the Hybrid System by means of light-gauge sheet steel manufacture, using modern welding processes.

The System is now firmly established in the industry and, through progress, will enter more and more industrial branches of process engineering as time goes on. HA