Spiral Heat Exchangers
This presentation contains a brief introductory description to the spiral heat exchanger, followed by information on construction, construction materials, operating limits and principal applications.
Where appropriate, a comparison is made with conventional shell and tube heat exchangers to emphasize size and weight reductions that can be achieved by using compact heat exchangers.
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Introduction

- The classic design of a spiral heat exchanger is simple;
- the basic spiral element is constructed of two metal strips rolled around a central core forming two concentric spiral channels.
- These channels are alternately welded, ensuring that the hot and cold fluids cannot intermix.
The heat exchanger can be optimized for the process concerned by using different channel widths.

Channel width is normally in the range 5 to 30 millimeters.
Spiral Heat Exchanger With End-Cap Removed (Giving Access to One Spiral Channel)
- Spiral heat exchangers tend to be self-cleaning.
- The smooth and curved channels result in a lower fouling tendency with difficult fluids.
- This self-cleaning effect results in reduced operating costs particularly when the unit is horizontally mounted.
In some cases double spacing may be used.

These double channel systems are used when there is a large flow rate or small pressure drop, but should not be used for fouling media or media containing solids.
Spiral Heat Exchanger Manufacture
Typically spiral heat exchangers are available in three configurations:

- **Type 1** – Media in full counter-current flow.
- **Type 2** – One medium in cross flow whilst the other is in spiral flow.
- **Type 3** – Combination design.
Type 1 – Media in full counter-current flow.

- The hot fluid enters at the centre of the unit and flows from the inside outward. The cold fluid enters at the periphery and flows towards the centre.
Type 1 - Spiral Flow-Spiral Flow Heat Exchanger
Type 2 – One medium in cross flow whilst the other is in spiral flow.

- The medium in cross flow passes through the open channels of the spiral usually in a vertical direction. The service fluid spiral flows through the other channel, welded shut, with side wall inlet and central outlet fed through the side wall as shown in Figure.
- This design can be used as either a condenser or vaporizer.
Type 2 - Cross Flow-Spiral Flow Heat Exchanger
· Type 3 – Combination design.

- A gas or vapor mixture to liquid exchanger combines the above two designs.
- The hot stream enters at the top and flows tangentially through the exchanger exiting at the side.
Type 3 - Combination Cross-Flow and Spiral Flow - Spiral Flow
Operating Limits

- The maximum design temperature is 400°C set by the limits of the gasket material.
- Special designs without gaskets can operate with temperatures up to 850°C.
- Design pressure is usually 15 bar, with pressures up to 30 bar attainable with special designs.
Principal Applications

- The design is ideal for fluids prone to fouling, or polluted with particles as a result of the relatively large channel width.
- Hence, it is ideal for use in the food industry.
- It has many applications in the chemical industry.
- Spiral heat exchangers provide temperature control of sewage sludge digesters plus other public and industrial waste plants.
Other applications:

- Spiral heat exchangers have perfect counter-current flow paths that permit the best possible overlap of exit temperatures.

- As such, they can maximise the heat recovery on large-scale cogeneration projects.

- Spiral exchangers can be mounted directly onto the head of distillation columns acting in a condensing or reflux role.
Specific advantages

- Ease of installation
- Low pressure drop
- Large flow cross-section.
- There are many condensing applications in all process industries particularly for condensing under vacuum.
Comparison with Shell and Tube Heat Exchanger

- Optimum flow conditions on both sides of the exchanger.
- An even velocity distribution, with no dead-spots.
- An even temperature distribution, with no hot or cold-spots.
- More thermally efficient with higher heat transfer coefficients.
- Copes with exit temperature overlap, or crossover.
- Small hold up times and volumes.
- Removal of one cover exposes the total surface area of one channel providing easy inspection cleaning and maintenance.
For the same duty, a spiral heat exchanger heat transfer area would be 90m² compared to 60m² for a plate and frame design or 125m² for a shell and tube design.
Heat Exchanger Size Comparison for Plate, Spiral, and Shell and Tube Heat Exchangers