The advantages of the vacuum system operating with mixing (direct contact) condensers are:

- very efficient due to direct contact between the process medium and the cooling medium
- low investment costs compared to indirect cooling
- simple and easy operation
- proven technology

The advantages of the vacuum system operating with surface condensers – compared to the conventional ones using mixing (direct contact) condensers – are:

- strict separation of cooling water and process medium
- environment-friendly e.g. low air pollution and clean cooling tower
- easy cleaning during operation
- proven technology supported by positive customer feedback
Vacuum systems for drying, neutralisation and bleaching processes

**Mixing (direct contact) condenser**

Direct contact between the process steam and the cooling medium is the most efficient way of steam condensation. This is why conventional vacuum systems operating with mixing condensation are still very popular for this application.

- Low operation costs and trouble-free and present operation are the main advantages of this kind of vacuum systems.
- Depending on the available cooling water temperature an upstream booster can be used.

**Surface condenser**

The initial idea for developing a vacuum system with indirect condensation was the requirement of environment-friendly systems in barometric and non-barometric design.

- Compared to conventional systems - with mixing direct contact condensers - the somewhat higher investment costs for such systems are rapidly paid back due to increased environmental protection.
- Positive feedback from customers and an increased number of installed systems show that the system operates successfully, reliably and trouble-free.

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**Vacuum systems consisting solely of ejectors**

- 1. mixing condenser
- 2. inter-stage ejector (stage 1)
- 3. inter-stage ejector (stage 2)
- 4. last stage ejector (stage 3)
- 5. seal tank
- 6. motive steam
- 7. cooling water
- 8. process flow
- 9. water separator tank
- 10. discharge flow

**Without booster**

- **Design parameter**: 100 kg/h water vapour
- **Motive steam pressure 9 bar (abs)**
- **Cooling water inlet temperature 32°C**

<table>
<thead>
<tr>
<th>Motive steam (kg/h)</th>
<th>Cooling water (°C)</th>
<th>Electrical energy (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>14.5</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motive steam (kg/h)</th>
<th>Cooling water (°C)</th>
<th>Electrical energy (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>20</td>
<td>—</td>
</tr>
</tbody>
</table>

**With booster**

- **Design parameter**: 100 kg/h water vapour + 10 kg/h air @ 40 mbar and 80°C
- **Motive steam pressure 9 bar (abs)**
- **Cooling water inlet temperature 32°C**

<table>
<thead>
<tr>
<th>Motive steam (kg/h)</th>
<th>Cooling water (°C)</th>
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</thead>
<tbody>
<tr>
<td>145</td>
<td>33.5</td>
<td>—</td>
</tr>
</tbody>
</table>

**Hybrid vacuum systems (combined with liquid ring vacuum pump)**

- 1. mixing condenser
- 2. inter-stage ejector (stage 1)
- 3. inter-stage ejector (stage 2)
- 4. last stage ejector (stage 3)
- 5. seal tank
- 6. motive steam
- 7. cooling water
- 8. process flow
- 9. water separator tank
- 10. discharge flow

**Without booster**

- **Design parameter**: 100 kg/h water vapour + 10 kg/h air @ 40 mbar and 80°C
- **Motive steam pressure 9 bar (abs)**
- **Cooling water inlet temperature 32°C**

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**With booster**

- **Design parameter**: 100 kg/h water vapour + 10 kg/h air @ 40 mbar and 80°C
- **Motive steam pressure 9 bar (abs)**
- **Cooling water inlet temperature 32°C**

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<tbody>
<tr>
<td>40</td>
<td>36</td>
<td>—</td>
</tr>
</tbody>
</table>

**All systems are designed to operate with pre-condensers, but an additional booster can be installed upstream of the condenser. By means of this installation a vacuum level below 10-15 mbar is easy to reach.**