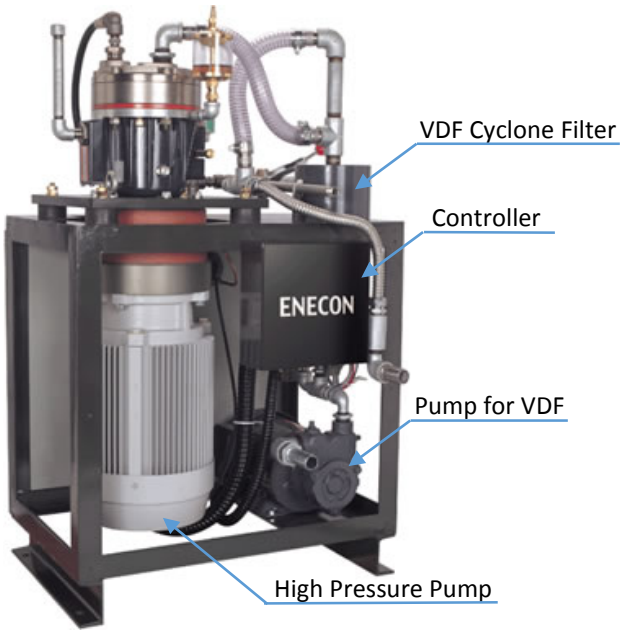
Enecon Cyver High Pressure Coolant System



Introduction

The Nukuni Enecon Cyver high pressure coolant system consists of a high pressure coolant pump controller, VDF coolant separator, and a pump to supply coolant to the high pressure pump via VDF. I can generate clean and optimized coolant pressure and flow, reduce energy cost, and maximize the product life of the high pressure pump.

Features and Benefits

- By using a variable frequency inverter, the full potential of the pump and the motor can be achieved which results in improving machine accuracy and performance.
- Improves positioning accuracy of drilling by dynamically adjusting the coolant pressure, reducing the pressure where the tools contact work pieces, then increase the pressure again after starting the drilling process.
- Avoids cracks in ceramic by dynamically reducing the coolant pressure prior to penetrating the surface.
- Can adjust coolant pressure specific to tool type, which makes it possible to use tools which weren't available to use with high pressure coolant, reduce process time, and increase tooling life time.
- Greatly reduces the total number of revolutions of a high pressure pump, which results in increasing the pump's product life, greater energy savings, and eliminates the need for chillers and air conditioner.
- Achieves quieter operation by reducing the operation speed of the high pressure pump.

Technical Details and Comparisons with the Traditional System

- Coolant flow rate at the high pressure pump:

  Traditional high pressure coolant pumps operate in constant speeds by using a fixed frequency power supplies. The flow rate depends on this constant speed.

  The Enecon Cyver controller dynamically adjusts the frequency taking coolant pressure and nozzle diameter to achieve the desired flow rate.
- Coolant pressure of the high pressure pump:

  The traditional system uses a pressure relief valve to set its maximum pressure.

The Enecon Cyver uses a 3bit digital signal (8 speeds) to dynamically control the pressure. The power frequency is controlled with a closed-loop control between input parameter and the pressure gauge reading.

- Coolant flow rate at the tip of tooling:

  The flow rate of the high pressure coolant discharged from the tip of the tooling depends on the nozzle diameter and pressure. With traditional system, the surplus flow is bypassed by the relief valve and returned to the coolant tank.

  The Enecon Cyver system dynamically adjusts the flow rate to match the required flow rate at the tool tip. Thus, the flow is not wasted and the bypass valve is only used as a protective mechanism.

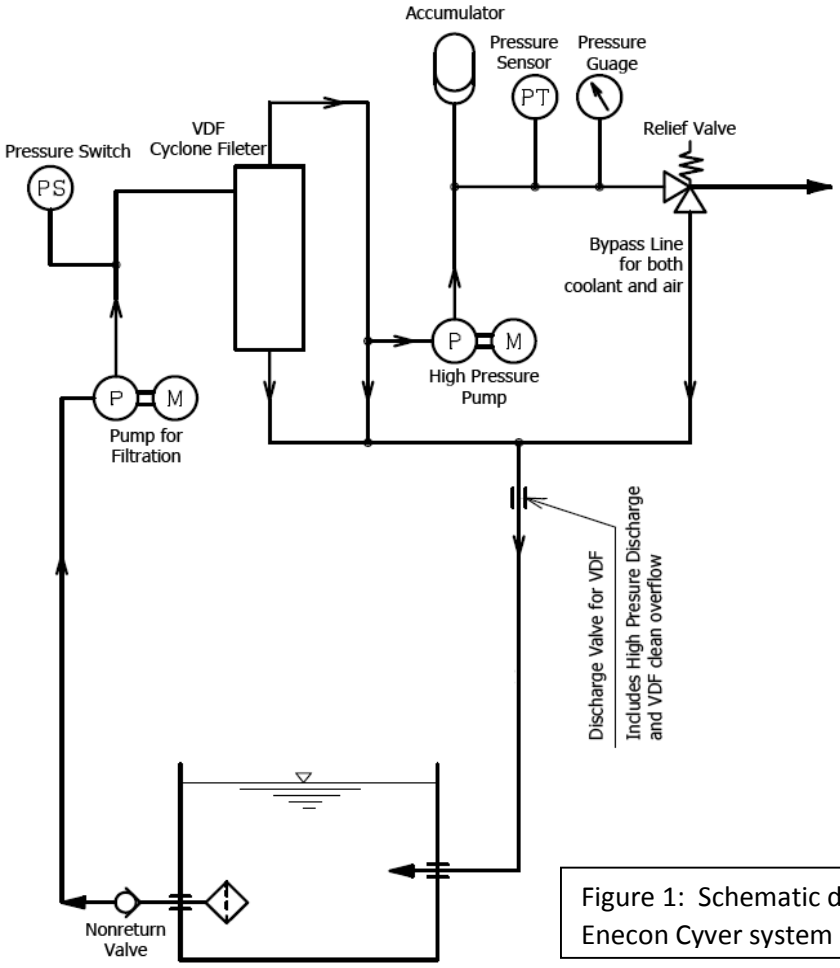


Figure 1: Schematic drawing of the Enecon Cyver system

- Surplus flow:

  As discussed in the previous section "Coolant flow rate at the tip of tooling" the Enecon Cyver system does not generate high pressure coolant surplus flow, which results in following benefits:

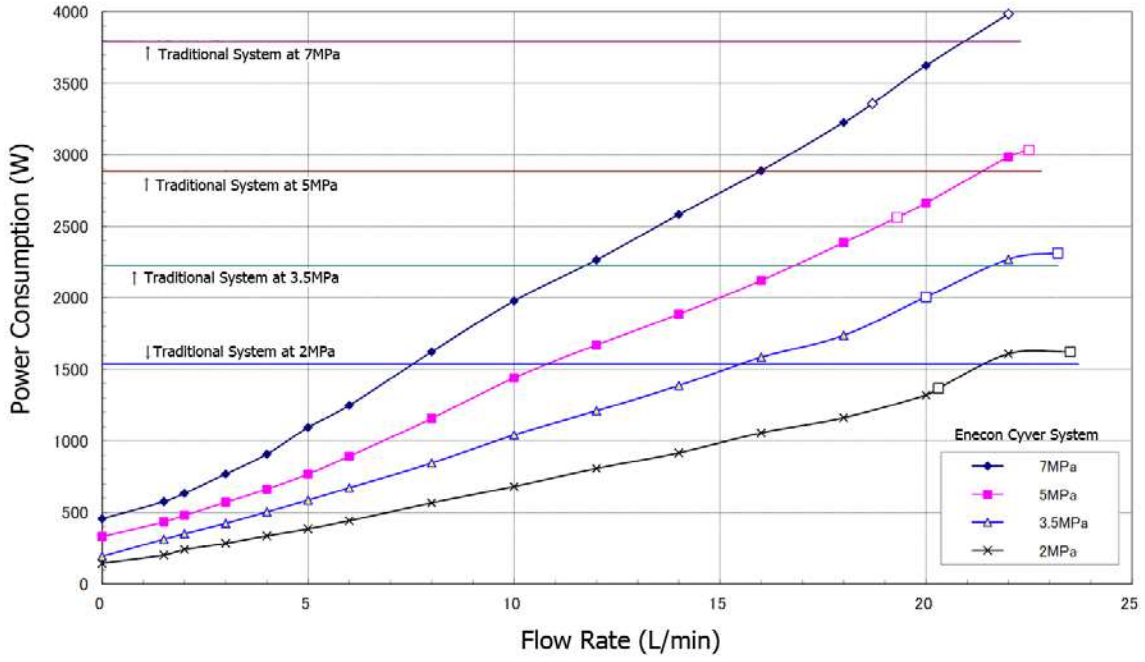
  - It can avoid energy usage to pressurize the surplus flow.
  - It can avoid a rise in coolant temperature generated by converting the pressure energy of the surplus flow to thermal energy.
  - It can eliminate use of a coolant chiller and an ambient air conditioner, along with their energy usage since it can minimize the coolant temperature rise.

- Fixed frequency mode (constant flow rate function):

  The Enecon Cyver system has two control methods, the pressure feedback mode and the frequency feedback mode. It can switch between the two modes during operation. The frequency feedback mode has advantages. In high speed machining rapid pressure changes make the pressure feedback control function unstable. The second advantage is that there are cases when increasing pressure is preferable when tool tip is blocked with a work piece.

- Energy savings:

  As it has been mentioned in previous sections, the Enecon Cyver eliminates surplus coolant flow thus greatly reduce the energy consumption. Graph 1 shows the difference in energy consumption in comparison to a traditional system. The smaller the flow rate required, the greater the energy savings rate, up to 85% for the high pressure coolant pump system, it does not include the energy savings gained by eliminating coolant chillers and air conditioners.



Graph 1: Differences in energy consumption by pressure between the traditional and Enecon Cyver System

Difference Compared to an Inverter with a Pressure Feedback Control System

The latest models of inverters, or VFDs, have a PID control function and it can achieve a similar system by combining with a pressure sensor. However, such a system lacks the following functions which the Enecon Cyver has:

- Inverters can't adjust the supply pressure quick enough to respond the condition change at the tip of the nozzle, or it will become unstable.
- Inverters require longer time to start up and to change the pressure setting.
- Frequency feedback control is not available with inverters.