Pumping matters

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Welcome

to this first edition of Pumping Matters our new Wanner International Newsletter. We intend to use this medium as a conduit through which we will pass information that may be useful to our distributors and their customers alike.

It will cover application successes, technical information, market updates and similar information. You will note that we have dedicated the first issue to high pressure cooling in machine tools. Following our recent participation in the Machine Tool Trade Fair in Hannover, two things have become abundantly clear... Firstly, that there is a discernable shift in the machine tool industry to High Pressure coolant delivery... And secondly, that the Hydra-cell is the ideal pump to meet the requirements.

In this issue I have tried to set out the case for high pressure coolant delivery and explain in simple terms the advantages of using a Hydra-cell pump for such applications.

I trust that you will find the information both informative and interesting.

Paul Davis

Managing Director

Hydra-Cell G-03 model

WHY HIGH PRESSURE COOLING?

High Pressure coolant delivery is quickly growing in importance as the preferred method of cooling and chip removal for many turning, milling and grinding operations. It is already the preferred solution for deep hole drilling where the coolant is fed to the cutting edge through the tool. There are many benefits to be gained by the employment of High Pressure coolant delivery:

- **Eliminates build-up of chips** – Flushes them out from deep holes and away from cutting zone
- **Prolongs tool life** – effective cooling and lubrication of the tip, predictable tool life
- **Improves work piece quality** – better cooling... less distortion; no debris, consistant work piece quality
- **Increases productivity** – faster feed rates, longer tool life
- **Reduces power requirements** – better lubrication.
- **Improves grinding performance** – eliminates wheel glazing

WHAT ARE THE REQUIREMENTS OF AN HP COOLANT PUMP?

1 FLUID COMPATIBILITY

Must handle all fluids, water miscible synthetics, semi synthetics, and soluble oils as well as neat mineral and synthetic oils in a range of viscosities.

2 'DIRTY' FLUID COMPATIBILITY

Should be unaffected by the presence of fines and dirty fluids.

3 FLOW / PRESSURE PERFORMANCE

Should be able to maintain flow rate whatever the required pressure

4 OPERATIONAL EFFICIENCY

Should operate cost effectively with optimum power utilisation (low dissipated power)

5 LONG LIFE, LOW MAINTENANCE

Must require minimal maintenance and be dependable in the rigorous working environment

WHAT IS OUR COMPETITION IN MACHINE TOOL, HIGH PRESSURE COOLING?

There are four basic types of pump currently used:

- Twin Screw pump (Most common)
- Gear pump
- Multi-stage centrifugal
- Multi-piston

All these technologies depend on dynamic seals or labyrinth type seals and each has drawbacks.

Hydra-Cell has no dynamic seals. It is seal-less and does not require fine filtration.

Hydra-Cell G-12 model

OPERATION EFFICIENCIES

Screw pump v Hydra-Cell.

Pump type	Q (l/min)	Pressure (Bar)	Absorbed power (KW)		Annual Euro saving using Hydra-Cell
Knoll KTS40-60	29	70	8.3	97% more energy than the Hydra-Cell	
Hydra-Cell G10	29	70	4.2		1,476 Euros
Knoll KTS20-30	4	80	2.8	147% more energy than the Hydra-Cell	
Hydra- Cell G03	4	80	0.7		756 Euros
Knoll KTS 60-90	118	80	34.5	78% more energy than the Hydra-Cell	
Hydra-Cell G35	118	80	19.5		5,400 Euros

Multi-stage Centrifugal Pump v Hydra-Cell.

Pump type	Q (l/min)	Pressure (Bar)	Absorbed power (KW)		Annual Euro saving using Hydra-Cell
Grundfos CRNE1-23 HS	29	40	5.62	122% more energy than the Hydra-Cell	
Hydra-Cell G10	29	40	2.53		1,112 Euros

Notes:

- Efficiencies are from manufacturers published data sheets
- Efficiencies are stated for emulsions, kinematic viscosity of 1 mm^2/s
- Annual cost savings are calculated using the following data
  - Average cost in Europe of electricity is 9 Euro cents per KW hour
  - Pump running for 4000 hours per year.

HANDLING FINES, PARTICLES AND DIRTY FLUIDS

All pumps designs other than Hydra-Cell depend on fine filtration to protect the pump. **Published data:**

- Knoll, screw pump particles ≤ 50 microns
- Brinkmann, screw pumps ≤ 50 microns
- Grundfos, multistage centrifugal ≤ 50 microns
- Voith, internal gear pumps ≤100 microns

Although filtration can be specified to, for example, 10 microns, this is a nominal value. There is a distribution of particles and if an analysis were done on the fluid after filtration absolute particles sizes of 250 microns could be found.

All the above pump types depend on close tolerances to achieve the pumping action; they therefore have a low tolerance to wear. Any solids entering the pump will cause wear to critical parts and thereby impair efficiency. In practice many companies use 5 micron filtration to protect the pump from fine particles. The pump manufacturers try to avoid wear by adding harder materials at the point of wear; however this does not solve the root cause of the problem as the basic design concept is not ideal for handling fluids with abrasive particles.

The Hydra-Cell does not have these design constraints and does not suffer these problems, since it is based on the seal-less principle. Hydra-Cell can handle particles of 500 microns plus; with no dynamic seals there is no need for fine filtration to protect the pump.

FLOW / PRESSURE PERFORMANCE

Linearity and stability are good to have in any pump to achieve predictable output. In the process of high pressure cooling, maintaining a consistent flow and pressure are important for predicable tool life and work piece quality.

Fig 1 shows flow and pressure performance, comparing a Hydra-Cell pump with a twin screw pump.

A number of points can be observed.

a. With both oil and emulsion coolants, flow from the screw pump is reduced as pressure increases. Therefore coolant flow rate and hence cooling ability is variable, making tool life and work piece quality also variable. The Hydra-Cell pump flow pressure characteristics are linear and flat giving constant flow independent of pressure. So the process has controllable predictable results.

b. When emulsion type coolants are used for the screw pump, the reduction in flow as pressure increases is even more dramatic giving even more unpredictable behaviour. The Hydra-Cell flow pressure performance stays linear and flat no matter what type of coolant technology is used. i.e constant flow independent of pressure.

c. Screw pump curves -The reduction in flow as pressure increases shows the result of slip, which occurs in screw pumps. If there is a blockage inside the work piece, such as in deep hole drilling, the screw pump may have difficulty in removing the blockage. The Hydra-Cell pump with the flat linear response is able to keep the flow rate constant and clear the blockage.

LONG LIFE AND LOW MAINTENANCE

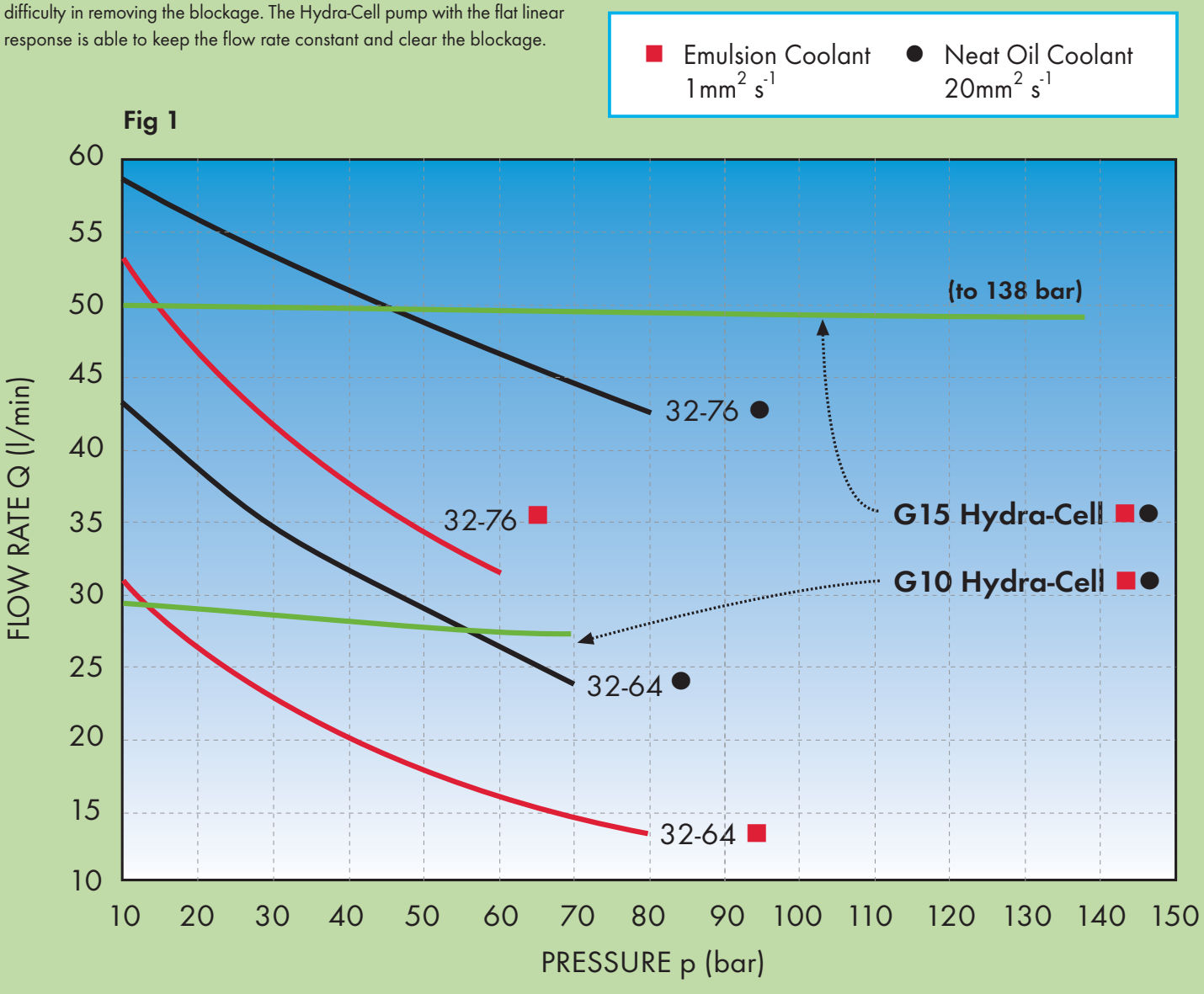
- Screw pumps, multi-stage centrifugal, internal gear pumps, piston pumps and progressive cavity pumps cannot run dry. If for some reason a mistake is made and the coolant tank empties these pumps will be damaged stopping production.

- Hydra-Cell can run dry. If mistakes are made on the shop floor with the coolant supply, the pump will not be damaged and production can restart immediately.

- Screw pumps, multi-stage centrifugal, internal gear pumps, piston pumps and progressive cavity pumps all need fine filtration and careful management of that system to protect the pump.

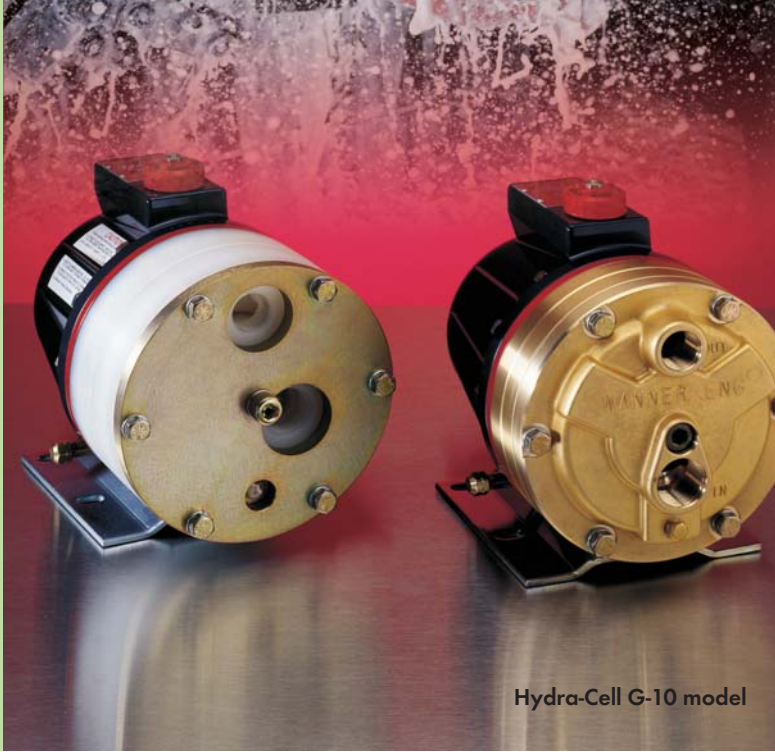
- When using a Hydra-Cell pump, the filtration system can be designed to the requirements of the cutting process and not to protect the pump. This can save on filtration, equipment and operating costs. One large volume machining shop saved €2000 per week on filtration costs after switching to Hydra-Cell pumping technology. Also if there is an issue with the filtration system and larger particles get through to the pump, during maintenance for example, the pump will is unlikely to be damaged.

Fig 1



SUMMARY OF HYDRA-CELL ADVANTAGES

- **Hydra-Cell** generates savings that can be made on purchasing and running costs of fine filtration equipment.
- **Hydra-Cell** generates savings in pump running costs.
- **Hydra-Cell** can withstand 'run dry' conditions without damage... insurance against operator error and filtration blockage.
- **Hydra-Cell's** ability to pump all types of coolant reliably means the pump can be removed as a variable in the process when considering different chemistries.
- **Hydra-Cell** offers controllable, predictable pressure and flow rates to maintain high productivity.
  - Consistent quality
  - Reduction in tooling costs
  - Can eliminate machine downtime due to pump problems
- **Hydra-Cell** is unaffected by particles in suspension (up to 500 microns) preventing problems caused by dirty coolant or impaired filtration.



Hydra-Cell G-10 model

FLUID COMPATIBILITY

Coolant technology is becoming more diverse with new chemistries entering the market. Coolants need not only to enhance the cutting process. They have to be ecological, economical and user friendly to meet the requirements of a modern world. An end user needs a pump that will handle all of these different coolant types without having to change the pump technology or process each time he chooses to change the coolant technology.

Evolving Fluid Technologies
Coolant technology is evolving rapidly. Watermix fluids are playing an increasing role, especially high-dilution fluids and chemical additives change rapidly to meet environmental and operational concerns.

Water-mix
Soluble oils (milky emulsions) – mineral oils with base emulsifier, and additive packages to enhance cutting performance (EP), prevent corrosion and degradation and reduce tool wear.
Semi-synthetics (translucent) – mixtures of synthetic and mineral oils, usually incorporating an emulsifier and additive packages to prevent corrosion and microbial degradation and enhance cutting performance.
Synthetics (clear or translucent) – mineral oil free fluids that offer better skin compatibility and reduced 'workshop fogging' which is thought to be potentially carcinogenic. Synthetics also tend to be less susceptible to microbial degradation.

Neat Oils
Mineral oils – non water miscible oils in a variety of viscosities and colours. May be reinforced with additives and incorporate biocides. Less likely to suffer microbial degradation than water-mix fluids
Synthetic oils – increasing in popularity these oils tend to be based on saturated synthetic esters. Derived from a renewable resource they are considered eco-friendly. They come in a range of viscosity grades.

The majority of 'modern' fluids offer little in the way of traditional lubrication relying on additive systems to modify surface hardness to prevent wear and the high pressure delivery and cooling properties of the fluid to remove the excess heat generated.

Non-lubricating fluids cause wear in pumps that depend on dynamic sealing for operational efficiency but are easily pumped with Hydra-Cell.

Fluid filtration down to 5 micron and below is commonly now available. At such levels, some additives can be removed through fine filtration.

Because of economic and ecological reasons, many users are switching to high dilution emulsion i.e. greater than 90% water which have lower inherent lubricity. Others (such as Mercedes) are pioneering the synthetic neat oil approach.

Hydra-Cell can handle any type of coolant without loss of efficiency. Other technologies do not fare so well.

Twin screw and gear pumps operate optimally with neat oils. They lose efficiency as the viscosity approaches water. (See fig 1 which shows one manufacturers data and the loss of flow when pumping a liquid of $1mm^2\ s^{-1}$ compared to one at $20mm^2\ s^{-1}$). Data for twin screw pumps and gear pumps is often just published for kinematic viscosities of between 20 and 46 $mm^2\ s^{-1}$. At the viscosity values of emulsions (around $1mm^2\ s^{-1}$) these pumps become very inefficient.

Hydra-Cell pumps maintain their exceptional pumping efficiency over the widest range of viscosities!

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