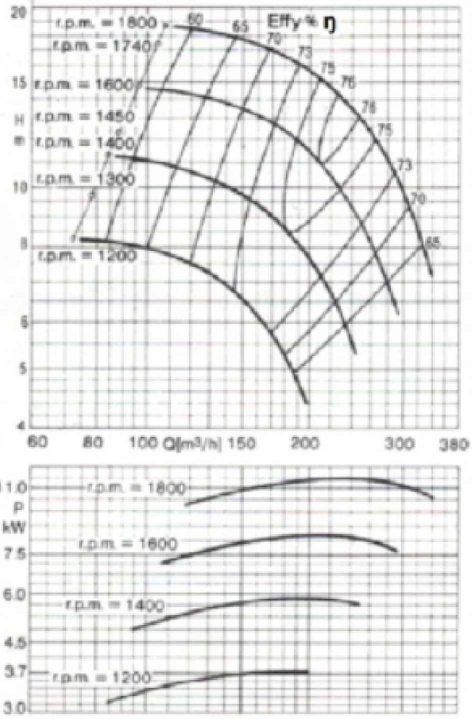

Fig. 1 Typical characteristics of a 7.5kW Centrifugal Pump

Pumping consumes a major part of energy used in many industries and is a prime target in energy management. The savings available by more efficient use of pumps can exceed 50% of running costs and provides a very rapid payback on capex, particularly with ever increasing electricity prices and other charges imposed. Variable speed control is the most effective way to regulate a pump so that this will only use the energy required to meet the desired demand.

The power consumed by a pump installation is based on pump affinity laws and is calculated by:

$$\text{Power (kW)} = k\,\frac{Q.H}{\eta}$$

Q = Volume (Flow) in m³/hr
H = Pressure (Head) in m
η = Efficiency of Pump+Motor %
k = Fluid density (water =0.27)

As can be seen from the Pump Curves shown in Fig. 1, as the flow is reduced in a fixed speed pump the head pressure increases well above the level required according to the System Curve to deliver that flow. i.e. The operating point (O) moves up the 1500rpm Pump Curve. The best operating point is where the System Curve meets the Pump Curve at Point O for 1500rpm, Point P for 1300 rpm, etc.

Speed Control of the pump allows the system to be optimised to meet the system requirements for applications such as maintaining a **Constant Pressure or Flow**, **Precise matching of the System Curve** and **Maximising Efficiency** to drastically reduce Power Consumption.

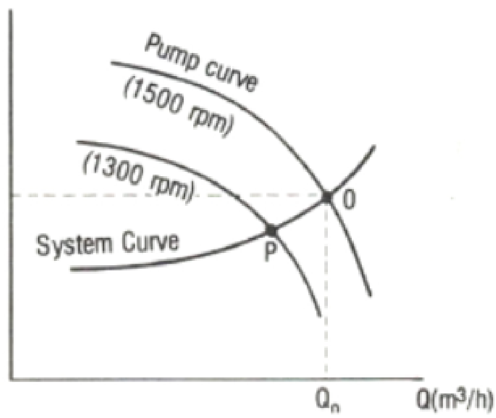

Fig.2

ADVANTAGES OF VARIABLE SPEED DRIVE CONTROL

Advantage	Result
• Improvement in System Efficiency	= Savings on running costs
• Simple automated control	= Precise Flow, Level or Pressure
• Reduced Starting Current	= Savings on Peak Demand Charges
• Smooth Acceleration	= Reduced Mechanical Maintenance
• Standard AC Motors	= Reduced Capital Cost

The major advantage is the savings in electricity costs that can be achieved.

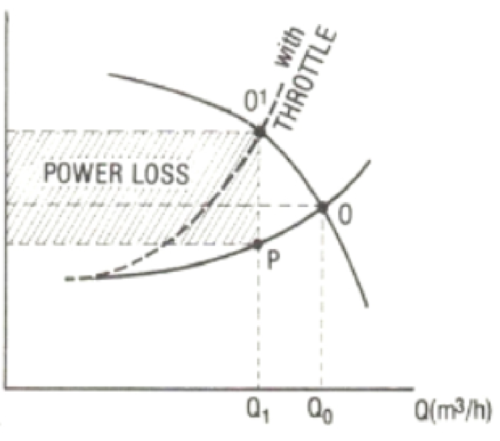

Fig. 4

METHODS OF REDUCING FLOW (Q)

Traditional and out-dated methods of reducing flow includes:

1. ON/OFF Switching (DOL)
   Other than the inconvenience of stopping and starting the pump, Direct on Line switching of electric motors can cause other serious problems in a pump installation. The high Starting Current causes electrical stress within the motor, as well as increase Peak demand charges, where applicable.

2. Throttling
   Flow is regulated using an in-line valve on the delivery side of the pump.This seems a relatively cheap way to regulate flow. However, from the Pump Curves in Fig.1, the head pressure of a fixed speed pump increases as the flow rate is decreased – in this case by partly closing the valve. The power wasted is directly proportional to the increase in head ($H_1 - H_p$) as shown in Fig.4

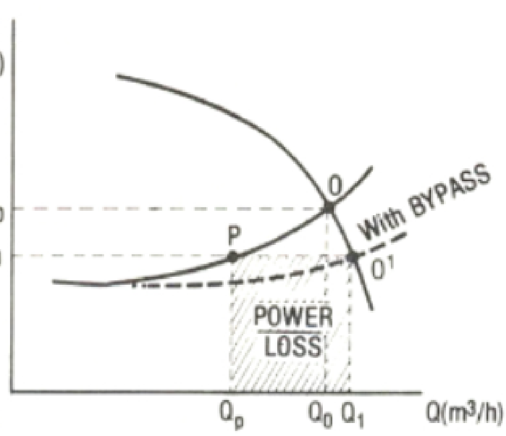

Fig. 6

3. Bypass System using a return valve back to the input of the pump.
   This diversion of fluid results in a considerable power loss. The system resistance is reduced as the by-pass valve opens causing increased flow (Q_2) through the pump. The power wasted is directly proportional to the by-pass flow ($Q_1 - Q_0$) and as shown as a shaded area in Fig.6.

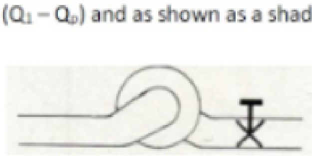

Fig.3 Flow Reduction by Throttling

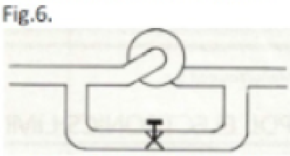

Fig.5 – Flow reduction By-pass

4. **Variable Speed**
   This is the most efficient method to control flow because the pump characteristic changes with motor speed without wasting power (see Fig 2.). The speed, and hence flow, reduction lowers both Head and Flow at the same time following the System Curve and only consumes the power required at each point.