

# Important Factors to reliably pumping wet cement with centrifugal slurry pumps

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Centrifugal slurry pumps are commonly used in wet cement plants to accomplish proper particle sizing, via raw grinding mills, as transfer pumps to move the process to blending, storage silos and in feed to the kiln.

High pumping reliability, minimum product dilution and easy maintenance are critical factors in pumping wet cement. *A.R. Wilfley and Sons, Inc. of Denver, Colorado has successfully applied slurry pumps to the cement industry worldwide for over 60 years.*

Wet process cement plants take feed from a quarry, sized to properly feed a ball mill, where water is added in the grinding process. Ball mill pump, pumps the slurry to cyclones or screens for proper particle sizing then transfers the slurry to blending tanks where the constituents are homogenized to ensure the chemical composition of the slurry is correct. Slurry pumps are then used to feed the slurry to a rotary kiln where heat is applied for pyroprocessing which consists of drying, calcining and sintering for the production of clinker.

To achieve pumping of cement slurries at the highest reliability and at minimum pump maintenance the following points should be considered.

1. Centrifugal pumps generate head pressure that acts against a pipeline system curve. To achieve the required flow rates the pump operating speed must match the system requirements. A centrifugal pump always operates at the intersection of the pump performance curve and pipeline system curve (see figure 1). If one's flow rate is too low or too high, the pump operating speed may need to be increased or decreased to match the system. Another possibility for undesired reduced flow rates may be a blockage or obstruction in the suction / discharge pipes.

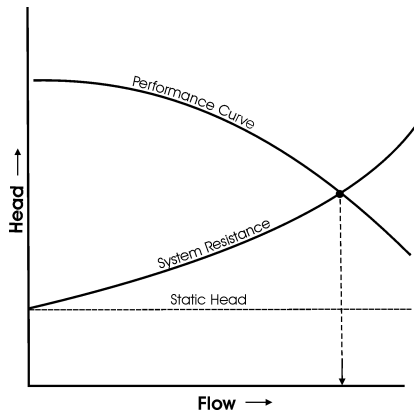
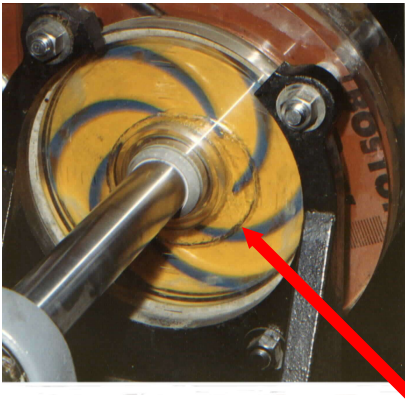


Figure 1.

2. Cement slurries fall into what is called a Bingham plastic fluid. This means that a certain critical shear stress (pressure) must be exceeded before flow (which is laminar or parallel to the flow direction) can occur and there is a maximum flow rate (where laminar flow transitions to turbulent flow) and the slurry becomes extremely difficult to pump using a centrifugal pump. The reasonable pipeline velocities (flow rates) generally fall in the 3.5-6.5feet/second range.
3. In the wet cement process, water is added to the ball mill to create the slurry (solids-liquid mixture) for transporting the solid constituents (limestone, clay, sand among others). However in the pyroprocessing water must be removed so it is desirable that the slurry pumps handle the highest concentration of solids (minimum amount of water). Kiln feed pumps will typically pump 65-68% solids by weight (1.65-1.70SG) or 45-50% by volume.
4. To achieve such high concentrations, adequate feed to the pumps is required, including proper pipe sizing to prevent solids settling causing line blockage and pump placement close to the feed tank to ensure good flow into the pump and high availability of NPSH (net positive suction head) to avoid pump cavitation. Cavitation results from low suction pressures whereby the liquid flashes to vapor in the eye of the impeller. This reduces pump performance and increases pump maintenance.

5. Pump seals are one of the highest maintenance and reliability concerns in a centrifugal pump. The most cost effective and proven method in wet cement is sealing via a dynamic seal. In this method an expeller, rotating with the shaft, imparts a velocity on the slurry and centrifugal forces move the slurry or pumpage away from the shaft of the pump (see fig 2). While the pump is operating the dynamic seal provides for zero leakage. Maintenance of packing and the addition of water through a packing gland seal arrangement are fully avoided. Most importantly there is no addition of water which must be removed from the process.



Dynamic seal creates air void around pump shaft

Figure 2.

6. Dynamic seals operate within certain parameters and must be carefully selected to match the application for maximum reliability and trouble free service. Maximum suction tank levels (suction pressure) must be understood to ensure that the dynamic seal capabilities are not exceeded. In certain instances variable speed drives may be used to control flow rates. Dynamic seals lose their sealing capabilities as pump speeds are decreased. As long as the operating parameters are understood, dynamic seals can be effectively employed to provide reliable sealing for the entire operating range.
7. Ease of pump maintenance should be designed into the pump installation and layout. Pump installations should consider ease of access and the availability of overhead cranes to assist in changing wet end hydraulic pump parts (impeller, case, liner parts) which will require periodic replacement. Wilfley Model K and HD pumps (figure 3) offer a unique side suction configuration which allows for easy replacement of the pump's hydraulic components without disturbing the suction and discharge piping.



Model HD pump

Figure 3.

8. Wet cement includes an abrasive mixture of limestone, silica, alumina, and iron components at high concentrations. For long wear life in the key hydraulic pump components a hard iron material provides the best results. Wilfley manufactures a number of hard irons but has found that our Maxalloy 2, a proprietary chrome-molybdenum hard iron, under ASTM A532 Class II, Type B material specification, provides the best wear performance in cement. Maxalloy 2 through special processing provides chrome-moly carbides interspersed in a hardened Martensitic matrix achieving a material hardness of 650-720 HBN.

Summarizing, the properly selected centrifugal slurry pump applied in a well engineered slurry pipeline system installed for adequate access for periodic maintenance can provide reliable high production in wet cement.

A. R. Wilfley and Sons, Inc. is a Denver, Colorado, USA based company manufacturing centrifugal pumps for abrasive and corrosive services since 1920. We have over 60 years experience in handling wet cement. For additional information you may visit our web site at [www.wilfley.com](http://www.wilfley.com) or contact us directly at 303-779-1777.