



HYDROCYCLONES



Innovations • Solutions

Hydrocyclone Series

Hydrocyclones are passive devices, used for the separation of solid particles in a process solution. The HDC Series separates to a specific predictable efficiency. The action of separation in a hydrocyclone is centrifugal force created by the rotation of the mass inside the cyclone body. The settling rate is inherent to the solution and depends on the size and shape of the particles, the viscosity of the liquid and, most importantly, the relative density and concentration of the solid particles in the solution.

Fluid Flow and Movement of Particles Inside the Hydrocyclone

Except for the region in and just around the inlet duct, the motion of the fluid within the cyclone body has circular symmetry. Incoming fluid moves in an outer helical flow to the outer portion of the cone where it begins to feed across toward the air core center. Some of the downward flow leaves through the apex while most of the flow reverses its vertical direction via an inner helical flow and discharges out through the vortex finder. A minor flow pattern short circuits along the top of the feed chamber around the outside of the vortex joining the fluid in the overflow.

Particles within the solution are accelerated outward toward the walls of the cyclone body by centrifugal force. This force is greatest on the particles of greatest mass (i.e. greatest size or relative density). As a result, the coarser, heavier solids migrate toward and along the inner wall of the cyclone leaving with some liquid as the underflow. The finer, lighter solids are largely entrained by the drag force of the liquid and leave the cyclone with most of the liquid via the overflow.

Hydroyclone Separation Efficiency

The common measure of the separation between the coarse and fine particles is the d_{50c} , commonly referred to as the cut point. The d_{50c} is the particle size diameter for which 50% by mass reports to the underflow. Solids progressively larger than d_{50c} size have a probability greater than 50% of reporting to the underflow.

The ALSI HDC Series is an efficient cyclone, improving separation and reducing short circuiting of fine particles. The ALSI HDC cyclones optimum set point for energy input to removal efficiency is 15 - 20 PSI delta P across the cyclone.

Hydroyclone Variables

The inlet section is rectangular in shape and is an integral part of the feed chamber liner. The area of the rectangular section is equivalent to the area of a circle, the diameter of which is referred to as the "equivalent inlet diameter" and denotes the inlet size.

Vortex Finder Diameter

A range of vortex finder sizes are available for each cyclone model. The vortex finder size has the greatest effect on cyclone performance for any given cyclone size; that is, the smaller the vortex finder, the finer the classification and the lesser the capacity of the cyclone.

Spigot Diameter

The spigot diameter is generally the most convenient variable to adjust or change and can be considered the "tuning" variable once a cyclone is installed.



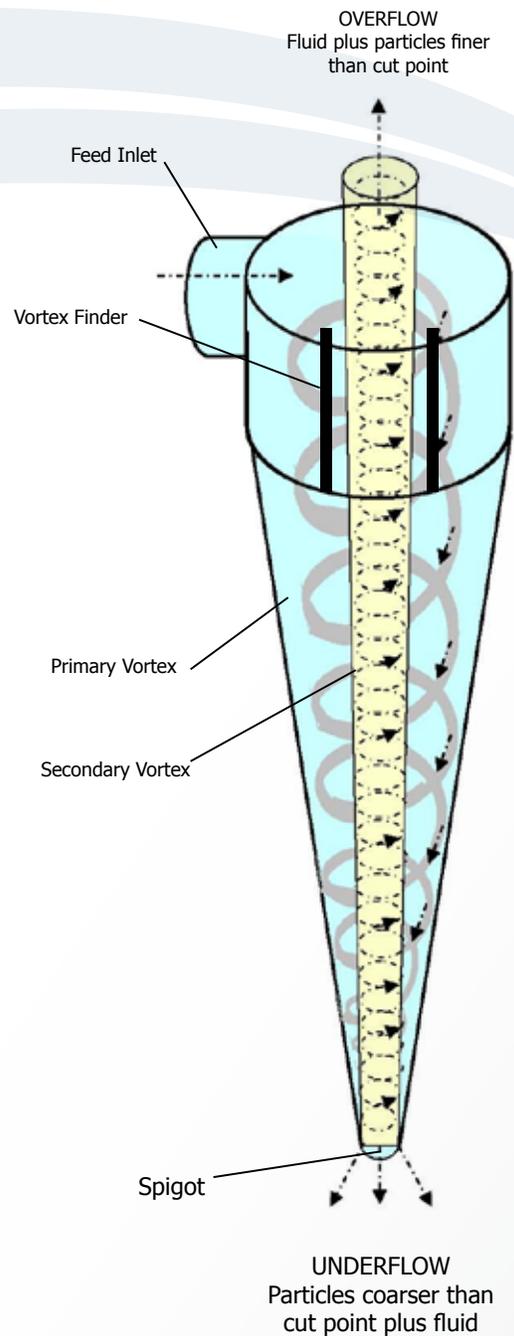
Cyclone Operation

Process solution enters the Liquid Cyclone through a tangential Feed Inlet, having a downward slope. Accelerated by centrifugal action, the process solution spirals downward through the Vortex Finder along the wall contour toward the small end of the cone. The undesirable heavy particles such as grit, weld balls, dirt, metal, etc., are forced by the Primary Vortex to the outer wall and carried down and out the Spigot of the cone. The cleaned solution spirals up the Air Cor center via the Secondary Vortex and exits out the Vortex Finder at the top of the cleaner.

In Automatic ALSI HDC Series Cyclones, the contaminants collect in a stilling chamber where the reject materials are separated from the solution and the rejects settle into a collection vessel at the bottom. A knife gate valve separates the stilling chamber and the collection vessel. The ALSI HDC Series purges the rejects through a timed control of two reject valves.

The manual liquid cyclone is emptied once or twice each shift by manually closing the reject collection vessel isolation valve, depressurizing the collection vessel, and opening the rejects collection valve. With both the manual and automatic system, there is almost no process solution loss and both are extremely difficult to plug.

The heart of any liquid cyclone is the replaceable cone cartridge. A thick aluminum oxide ceramic wear surface maximizes the service life of the cone cartridge. All other wetted parts in the ALSI HDC Series are cast iron/carbon steel, or optional stainless steel. The knife gate valves available are specifically designed to operate at extremely high reject concentrations. The knife gate valves for the ALSI HDC Series includes proximity switches and actuators for unattended operation and monitoring.



Answer ↑Effect	ΔP	d_{50c}	% Solids Underflow	% Solids Overflow
Q_{Feed}	↑	↓	↑	↓
D_{Vortex}	↓	↑	↑	↑
D_{Apex}	↓	↓	↓	↓
D_{Inlet}	↓	↑	↓	↑

Cyclone and External variables and effects on performance

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