A Research into Experimental Setup for Multi Hydrocyclone and its Performance Comparison

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Abstract - Multi hydrocyclone arranged in parallel and series manner would increases the performance when compare to the single hydrocyclone to investigate the multi hydrocyclone experiment. A hydrocyclone is a device that can successfully split multi-stage combination of solid particles present in liquid, based on the principle centrifugal force. Its application in mining, textile, petroleum, chemical and textile industries. In this research 100mm hydrocyclone used for separate the particles from fluid and quartz sand is used as particles (150 microns). When hydrocyclone arranged in series, the output from vertex finder of first hydrocyclone has been fetched an input for second hydrocyclone in series. When the Multi hydrocyclones are connected in parallel the both hydrocyclones are connected by a single connection through a bend pipe. Multi-hydrocyclones are more efficient compared to single hydro cyclones. The performance of the multi hydro cyclone is determined by the recovery efficiency. The hydrocyclone are arranged in series and parallel. The energy consumption of the multi hydro cyclone is reduced as two hydrocyclones were operated using a single pump. Experimentally a setup is required. This presents the research work on development of the single setup where both the arrangement (Parallel and Series) can be investigated.

Keywords - Multi Hydrocyclone, High Efficiency, Centrifugal Force.

I. INTRODUCTION

Hydro cyclones separation is a method of moving particles from a liquid, without the utilization of channels, through vortex split. Rotational impacts and gravity are utilized to split the combination of solids and fluids. Most normal types of particles eliminate quickly heavier particles make a difference to gather on beyond the separator by divergent power, where it is gathered and taken out. A hydro tornado is a basic cone-formed barrel shaped holder that has no moving parts. Also, multi hydro typhoons are more successful for eliminating the residue particles contrasted with single hydro cyclone. Vertical typhoon separators are utilized to eliminate fluids from solids particles of 5 micro meters. The multi hydro cyclones are connected in parallel or series.

Re-creations carried out for different hydro-cyclone putting together plans utilizing exploratory results from mono-phase broad-point hydro-cyclone isolates when control aerosol in a 25 mm estimation hydro cyclone. Combination of tiny quartz and iron oxide or FeSi of comparable dimensions were utilized to address minor thickness (e.g., soil) and major thickness (e.g., weighty alloy pollution) molecules, independently [1]. Two indistinguishable 10-mm hydro cyclone associated in series for further developing molecule partition proficiency is concentrated on utilizing two particulate examples [2]. Smaller than usual hydro cyclones stand out because of their benefits of further developed partition accuracy, minimal expense, simple activity and high strength [3]. A hydro cyclone is a device it utilized for divide particle or impurities present in fluid [4]. Usually, hydro-cyclones do not reach these lowcut sizes 5 microns. The process of the outfitted with a unique under flow box that put away the coarse particles in scope of not exactly the 5 microns will isolate at the proper time [5]. The fundamental use of hydro-cyclones in most regions is the unit of molecules from liquids. A hydro-cyclone could be an optimistic extension in water purification plants for centrifugation of contaminations [6]. The outcomes showed the Multi Hydro-cyclone's (MHC's) true capacity for huge scope application in microplastic partition for modern and metropolitan waste water [7]. In this paper, we present an innovation in light of hydro cyclone that successfully breaks the unions and eliminates sand. We utilized polypropylene powders and silica sands alternative for the hydrates and sands, and we added concrete to recreate the combination [8]. The effect of multi-inlet flow types of A, B, C cyclones. The multi-inlets cyclone is quite effective at improving particle separation performance compared to the standard single hydro cyclone [9]. Definitely hydro cyclones expect an essential part in powder development, which can stunningly impact the plant's process efficiency [10].

A definite relationship to figure the earth volume division as a piece of the hydro-cyclone head loss as well as the brand name obvious requirement of the hydrocyclone family were gotten [11]**.** The Re-treatment of fine particles in propensity of a devastating portrayal hydrocyclone can cause mineral over-pulverizing, decreasing both the metal recovery and the ball plant throughout. This issue is would in general in this concentrate by proposing a W-framed hydrocyclone that really decreases the fine particle in the propensity [12]. Of late, hydro-cyclones have been inspected to deal with their show. This study expected to survey the difference in the supply channel of a hydro-cyclone [13]. This work presents upheld computational liquid parts guesses of the impact that adjustments of vortex locater and ramble widths have on the social event execution of scaled back hydrocyclones. Little hydrocyclones have been applied successfully to the unit of micro-sized particles [14].

An assessment of the exploratory information exhibits that the fundamental furthest reaches of hydrocyclones essentially influence the stream field structure, and the preliminary movement conditions simply influence strength of the stream fields. Vortex finder significance influences the volume of the essential parcel zone and division execution of more modest than expected hydrocyclone. The best significance of the vortex finder was seen as an extent of vortex finder significance to more modest than ordinary hydrocyclone round and empty fragment [15]. A hydrocyclone is a strong parcel contraption where in water is mixed in with sands. It might be utilized to orchestrate or channel areas of strength for unequivocal furthermore, liquid parts in a supply stream. This study looks at the stream field brand name inside the hydrocyclone [16]. In this survey, a hydrocyclone was arranged and created to achieve a channel stream rate of 1 L/min in the preliminary, which was coordinated using soda lime spot with a specific gravity of 2.5. Numerical assessment was performed with Recognizable, utilizing the Reynolds stress aggravation and volume of fluid multiphase stream examination models [17]. Hydrocyclones are utilized for course of action objectives in the mining and mineral taking care of adventures [18]. Numbering-up of tiny hydrocyclone is as a rule used to further develop the dealing with breaking point of waste water treatment when more modest than expected results [19]. When the hydrocyclone's size is reduced the efficiency of particle separation is very high [20].

The energetic outcomes are separated and those got examining clear setting (without power). The outcomes showed that the endeavoured hydrocyclones present exceptional thickener gear and that the blazing Pareto's bend gives less arrangement in association the clear strategy [21]. Hydrocyclone has been broadly utilized in different division procedures. For instance, in the sewage source heat siphon framework, a De-Foulant Hydro cyclone with Reflux Ejector (DFHRE) can totally utilize the motor force of its flood to inhale its propensity and evacuate the impurities pouring out with the tendency [22]. Compound hydro-cyclone is a sort of unique hydro-cyclone likewise with the upsides of non-dynamic hydrocyclone. In this examination, the impact of working boundaries on partition execution of compound hydrocyclone is concentrated on utilizing both CFD method and trial technique [23]. A type A, B, C, D hydro-cyclone exhibits high molecule detachment execution. By its utilizations of slanted ring, focal bar and peak cone detachment execution is gotten to the next level. After effects of molecule direction perception concur with CFD recreation. The Sort D cyclone exhibits best molecule partition execution [24]. Smaller than expected hydrocyclones certainly stand out because of their benefits of further developed separation accuracy, minimal expense, simple activity and high steadiness. Not with standing, as a result of little treatment limit of a little hydrocyclone, various smaller than usual hydrocyclones should be associated in lined up with meet limit of treatment for modern applications [25].

Reusing of diatomite in a pure water filtration framework was explored [26]. Under the joined activity of the inward twirling stream furthermore, the circling stream, both underestimate and oversize nozzle upper width creates the negative order execution of the round and hollow hydro cyclone [27]. A multi-component system is created when the supply to the hydro-cyclone in quartz processing circuits is made up of various density molecule systems with different angles of Deliverance and sizes. Hydrocyclone separation is impacted by the interaction of these various density components, particularly at high feed solids concentrations [28]. In this review, a counterfeit combination of silica and magnetite with various extents is utilized for multi-part characterization tests in a 75 mm hydrocyclone. The cycle has a new water utilization for starch extraction and refining of 300 - 350 lit potatoes or-1.9-2.2tof water per ton of refined DS starch, because of the remarkable mix of interaction stages by adjusting a hydrocyclone framework, screens, and diffusive separators.

II. REFERENCE MODEL

Fig 1 shows Specification single hydro-cyclone. The chamber area and cone segment of the hydrocyclone was created by utilizing S.S. (Tempered steel) sheet of 2.5mm thickness. Financially accessible 24mm measurement tempered steel pipe was utilized to create the channel and outlet segments of the Hydrocyclone. Chamber segment distance across. The breadth of chamber segment of the typhoon ought to be twice the flood pipe width. For this undertaking chamber measurement is 100mm. Chamber segment length: Commonly, hydrocyclone have a chamber area length equivalent to or more prominent than the hydrocyclone breadth is 155mm. The length of chamber segment ought to be multiple times the flood pipe width. In the Cone segment length. The most metal products and for complex projects. Arc Welding is used for the fabrication of joining the two metals. The different types of electric rods are use mild steel and stainless steel.

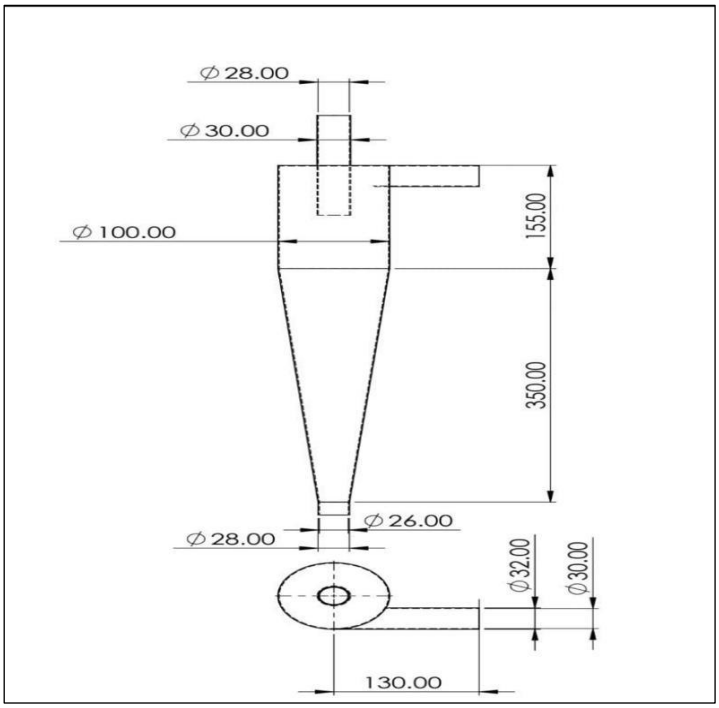

Fig 1. Specification single hydro-cyclone.

In this experiment utilized centrifugal pump for pumping the water into the hydrocyclone. Because of it was low maintenance, smooth flow and energy efficiency. In this experiment we use ball valve for control the fluid flow. Because of it was easy to handle.

III. HYDRO CYCLONE FABRICATION

Cutting

Cutting is the process of splinting in materials. For the cutting process the power cutting machine. It is a hardened metal tool used in the machining process to remove material from a work piece by shear deformation and cut and shape it. It is easier to cut metal into different shapesand sizes for multiple uses

Bending

The Roller bending is used for bending the metals. The three-roll plate twisting machine is utilized to twist the parts with equivalent thickness and variable thickness in the thickness course. There are two sorts of profile roll twisting parts. equivalent ebb and flow and variable shape.

Welding

Welding is a manufacture interaction by which at least two sections are intertwined through heat. Circular segment Welding, utilizes a tungsten terminal bar that makes a short bend to weld heavier metals, for weighty manufacture. This strategy requires a profoundly gifted welder, as the cycle is more troublesome, yet might it at any point be utilized on most metal items and for complex undertakings. Bend Welding is used for the fabrication of joining the two metals. The different types of electric rods are use Mild steel and stainless steel.

Machining

The metal assembling procedure called machining insinuates the technique engaged with framing metal by wiping out the unwanted material from it. In the also wrapped up by using the power cutting machine. surface wrap up by consistently disposing of the overflow material from the preformed clear as chips with the help of cutting tool(s) moved past the work

IV. EXPERIMENTAL ARRANGEMENT SET UP

Arrangement of hydrocyclone in series

In this experiment, hydro-cyclones are connected in series. The distance between the two hydro-cyclones was 800mm. Before the water was entered to the hydro-cyclones, one kg of particles (green sand) mixed with water. Particle size is 150microns. After that, the mixture was sent to first hydro-cyclone. We collect 0.35 kg of particle by the under flow of the first hydro-cyclone and over flow of the first hydro-cyclone was directly connected to the inlet of the second hydro-cyclone. We collect 0.40 kg of particles by the under flow of the second hydrocyclone.

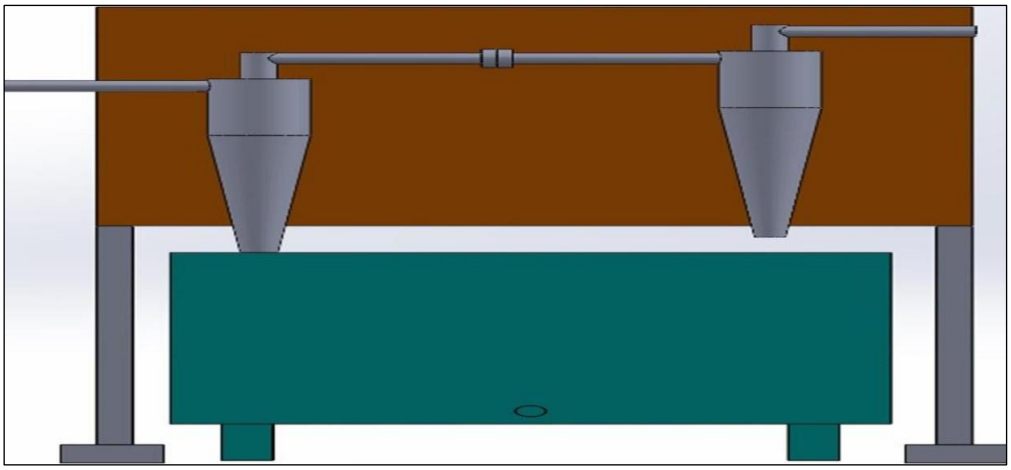

Fig 2. Arrangement of multi hydrocyclone in series manner (Front View).

Table 1. Performance Table Forhydrocyclone In Series.

S.No	Valve Position	Pressure (P_1) bar	Pressure (P_2) bar	Pressure (P_3) bar	H1	H_2	H=H1+H2 (in kg)	E (%)
1.	Full open	0.981	0.735	0.196	0.35	0.40	0.75	75
2.	Semi open	0.735	0.589	0.098	0.20	0.20	0.40	40
3.	Partial open	0.147	0.049	0.0098	0.10	0.10	0.20	20

Fig 2 shows Arrangement of multi hydrocyclone in series manner (Front View). Initial mass of the particle (green sand) is 1kg.Above the observation, the valve position when fully opening, particles collected in both of the hydrocyclone was 0.75kg and efficiency was high (75%) at valve when fully opened. Table 1 Performance Table forhydrocyclone in series.

Arrangement of hydrocyclone in parallel:

In this experiment, hydro-cyclones are connected in parallel. The distance between the two hydro-cyclones was 400mm.Before the water was entered to the hydro-cyclones, one kg of particles (quartz sand) mixed with water. Particle size is 150 microns. After that, the mixture was sent to first hydro-cyclone. We collect 0.25 kg and over flow of the first hydro-cyclone was connected to the inlet of the second hydro-cyclone. We collect 0.30 kg of particles by the under flow of the second particle. The desired output was get from the overflow of second hydro-cyclone.

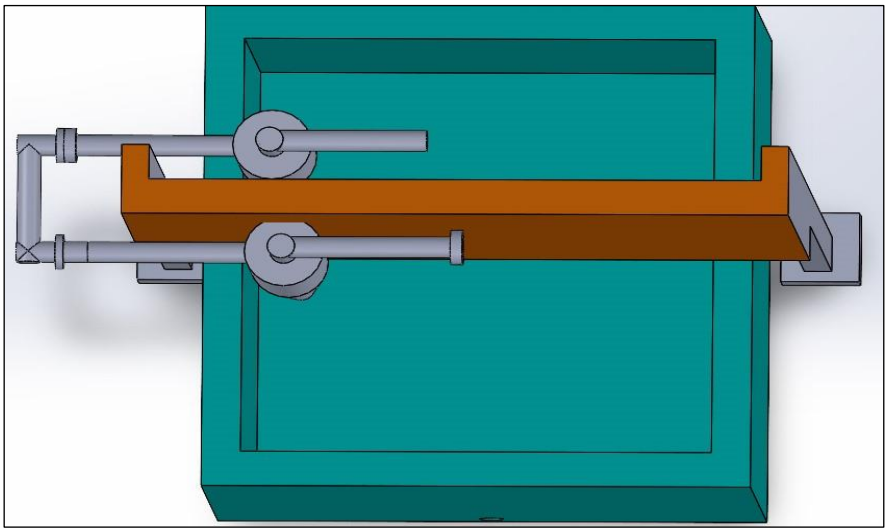

Fig 3. Arrangement of multi hydrocyclone in parallel manner (Top View).

Table 2. Arrangement Of Hydrocyclone In Parallel

S.No	Valve Position	Pressure (P_1) bar	Pressure (P_2) bar	Pressure (P_3) bar	H1	H_2	H=H1+H2 (in kg)	E (%)
1.	Full open	0.490	0.343	0.098	0.25	0.30	0.55	55
2.	Semi open	0.343	0.245	0.049	0.10	0.15	0.25	25
3.	Partial open	0.102	0.0098	0.0088	0.05	0.10	0.15	15

Fig 3 shows Arrangement of multi hydrocyclone in parallel manner (Top View). Initial mass of the particle (quartz sand) is 1kg.Above the observation, the valve position when fully opening, particles collected in both of the hydrocyclone was 0.55kg and efficiency was high (55%) at valve when fully opened. **Table 2** Shows Arrangement of hydrocyclone in parallel.

V. RESULT AND DISCUSSION

The outcomes got from the analysis on plan, creation and testing of hydro-cyclones are discussed about in this segment.

Hydro-Cyclones in Series

$$E = [(H_1 + H_2) / \text{Mass of the particles}] \times 100 \quad (1)$$

Where, E= Efficiency
H_1= Particles collected at first hydro- cyclone
H_2= Particles collected at first hydro-cyclone
$E_1 = [(0.35+ 0.40) / 1] \times 100 = 75\%$
$E_2 = [(0.20+ 0.20) / 1] \times 100 = 40\%$
$E_3 = [(0.10+ 0.10) / 1] \times 100 = 20\%$
Where, E_1= Efficiency at valve was fully opened
E_2= Efficiency at valve was semi- opened
E_3= Efficiency at valve was partially opened
Above the calculation we concluded that efficiency is high in when valve position at fully opened.

Hydro-Cyclones in Parallel

$$E = [(H_1 + H_2) / \text{Mass of the particles}] \times 100 \quad (2)$$

$E_1 = [(0.25+ 0.30) / 1] \times 100 = 55\%$
$E_2 = [(0.10+ 0.15) / 1] \times 100 = 25\%$
$E_3 = [(0.05 + 0.10) / 1] \times 100 = 15\%$
Where, E_1= Efficiency at valve was fully opened
E_2= Efficiency at valve was semi- opened
E_3= Efficiency at valve was partially opened

According to the calculation, it is concluded that separation efficiency is higher in the series set up. The following graph shoes that separation efficiency of two various set ups in multi hydro-cyclone.

VI. CONCLUSION

In Multi hydrocyclones more effective forremoving the dust particles compare tosingle hydrocyclon. The longer length provides longer residencetime while the smaller diameter createsgreater centrifugal force. These two factors result in better separation (Multi hydrocyclones) of dust particles. Above the experiment, the efficiency of particle separation is higher in series connection compare to the parallel connection. Because the pressure difference between (P_1 and P_3) when the hydrocyclones were connected in series is 0.185 bar.But the pressure difference between (P_1 and P_3) when the hydrocyclones are connected in parallel is 0.392 bar .So the pressure plays the major role in separation of solid particles from fluid. So, series set up is more efficieny when compare to th parallel. The main advantage of a multi-hydrocyclone system is its ability to handle high flow rates while maintaining a small footprint.This makes it ideal for applications where space is limited but high separation efficiency is required. Multi-hydrocyclone systems are commonly used in the mining industry for separating solids from liquid slurries. They are also used in the food and beverage industry for separating solids from liquids, such as in the production of fruit juice. Overall, the multi-hydrocyclone is an efficient and effective way to

separate solids and liquids in a variety of industrial applications, offering high throughput and separation efficiency in a compact design.

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