



Studies and Research on Dust Separation Technology: A Review

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Abstract

In air pollution Dust place a major factor and to separate dust from air is tedious task. But a social and control point of view separation is mandatory. This paper reviews about technologies like cyclone separator, granular filter, hydro cyclone separator, electrostatic precipitator for dust separation. Dust may be normally separated by using centrifugal force, density difference, absorption and adsorption. Industries which manufacturing street cleaning equipments below suggested technology is finest technology are to implement. The review summarizes best dust separation technology and its optimization.

Key words

Swirling flow, Fractional efficiency, Flow analysis, Pressure drop, velocity distribution

1. Introduction

A global development has dual face white and black face. Reason for black face is Environmental pollution. Industries, New technology have least concern about pollution. The outlet of industries contain no of gases and these gases plays major part in pollution but dust also have its own contribution to the pollution level. Separating dust from air has different technology but selecting best is difficult task. Dust can be separated by air using density difference between air and dust. This paper relatively concentrated on cyclone separator, electrostatic precipitation, water spraying, and granular filters dust separation. In cyclone separator a swirling flow separates dust from air ascending flow push air up outlet of cyclone and descending flow made to collect denser particle at dust outlet.

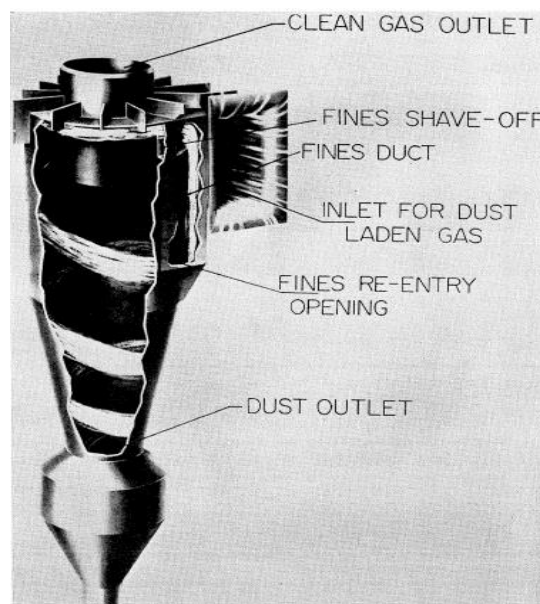


Fig.1 Cyclone separator

Wet electrostatic precipitator has electrode and which collects dust by means of adhesion property of It.

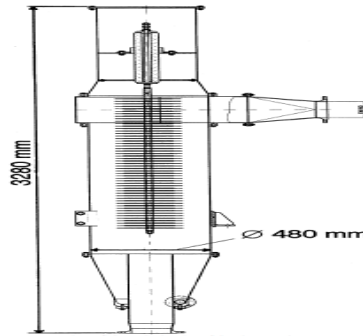


Fig.2 Electrostatic precipitator

Water separating technology is increases density of dust and made to fall by gravity which separate dust from air. Granular filter which absorbs dust and gives outlet as filtered air.

2. Research and study on cyclone separator: a Review

A research paper Mechanical dust collector by Charles A., Gallaier , J.W.Schindeler [1] gives dimensional data for cyclone . There are two parts in cyclone one is upper and cone shaped lower part This paper clearly specify the fractional efficiency (1 to 2 micron particle it can trap 3.1%) of particle collection in each part.

Particle size-microns	Particle size distribution	Fractional efficiency	Percent collected
0-2	10	19	1.9
2-4	8	46	3.6
4-6	8	53	5.05
6-8	7	75.5	5.65
8-10	6	83.5	5.00
10-15	14	91.5	12.80
15-20	10	97.0	9.70
20-25	8	98.9	7.91
25-30	7	99.5	6.96
30+	22	99.75	21.52
	100		80.52

Table1. Cyclone Upper part Data

Particle size-microns	Particle size distribution	Fractional efficiency	Percent collected
0-2	10	39	3.90
2-4	8	77.5	6.21
4-6	8	91.8	7.34
6-8	7	97	6.78
8-10	6	98.9	5.94
10-15	14	98.9	13.96
15-20	10	99.99	46.95
20-25	8	99.99	
25-30	7	99.99	
30+	22	99.99	
	100		91.08

Table 2. Cyclone lower part data

This paper also specifies the pressure drop in cyclone and its series connection to improve the efficiency of cyclone. Dust Generation and separation by Hitesh Kumar, Karan Bhatia, Vaibhav Puraswami [2] presented a field where the dust generation takes place like in drilling, blasting, machinery equipments, belt conveyor in Mines. This paper also gives idea of techniques to separate dust like wet drilling, dry drilling, water spray system, ventilation method. Two-stage Cyclone Type Dust catching plant with granular filter a presented paper by V.S.Sharagazo [3] explains two stage dust separation with arrangement cyclone separator with filter attached to it. It is giving 95 to 99% separation efficiency. There are 2 cycles one filtration cycle and other one is cleaning cycle. To clean the filter usage of vibrator is most effective. Velocity distribution in hydro cyclone separator by M.J.Fisher and R.D.Flack [4] gives idea of internal flow field in hydro cyclone. They uses laser velocity meter to study in seven axial planes investigated at three independent inlet, three independent outlet and reject rates. Industrial separation of fine particles with difficult dust particle a paper by W.Peukert, C waden Pohl [5] presented wet electrostatic precipitator give experimental efficiency then as theoretical predicted. But because of economical effective he conducted on experiments on wet scrubber and fabric filter. Parametric Study Of Phase Separator used in A/C Automotive system by using CFD tool a paper by Thundil Karuppa Raj R, Alen Jose, Ajo John Thomas and Mathew James [6] explains technique of phase separation using cyclone. Multiphase model is separating different phase like solid, liquid and gas. This paper suggested that different model for mixing of phases. Numerical Study on Particle Motion in Swirling Flows Cyclone Separator by Kazoyoshi MATSUZAKI, Hideaki USHIJIMA, Mizue MUNEKATA, Hideki OHBA [7] presented detail numerical simulation using large eddy simulation.

Model. It gives idea of finding efficiency of cyclone separator and finding particle separation model. Numerical Study of Gas-liquid Micro-cyclone Separator Flow Field by Peng Qian, Yiy Liu, Liang Ma, Yanhong jang 3 [8] dimensional flow analysis is carried out the analysis is done based on Reynolds stress model. CFD Simulation Study on Particle Arrangements at the Entrance to a Swirling Flow Field for Improving the Separation Efficiency of Cyclones by Liang Ma¹, Pengbo Fu, Jingping Wu, Fei Wang, Jianping Li, Qisong Shen, Hualin [9] Wang presented a CFD analysis of normal cyclone, Positive Rotation cycle Reverse Rotation cycle. Reverse rotation cycle have more efficiency of separation of Heavy particle. A Review on Gas Solid Cyclone Separator Parametric Analysis by Shah Nikhil [10] presented design and simulation of cyclone separator.

Analysis Of Cyclone Separator Using Empirical Models And CFD For Variation Of Dimensions Miss. Prajakta Tapkir, Dr. Dinesh Kamble [11] explains Numerical study and CFD analysis of cyclone and this paper also explains change in pressure and velocity when dimension of cyclone changes. Analysis Of The Efficiency Of A Cloth Cyclone: The Effect Of The Permeability Of The Filtering Medium by M.V.Rodrigues, F.O.Arouca, M.A.S.Barrozo and J.J.R.Damasceno [12] In this paper Conical output is replaced by filter which consequently increases collection efficiency of cyclone. The Performance Of Oil-Gas Cyclone Separators In Oil Injected Compressor Systems With Considering The Breakup Of Oil Droplets by Xiang Gao, Yaopeng Zhao, Jianmei Feng, Yunfeng Chang, Xueyuan Peng [13] This paper done study of CFD analysis of break up in oil droplets. Design Of Cyclone And Study Of Its Performance Parameters by Mahesh R Jadhav [14] present a design analysis of cyclone. The Effects Of Vortex Finder On The Pressure Drop In Cyclone Separators, by erit Ficici, Vedat Ari And Murat Kapsiz [15] This paper explains analysis of pressure drop due to dimension changes vertex of cyclone. Study Of Design Of Cyclone Separator Under Collection Efficiency And Air Density Effect By Radhe Shyam Verma, Prakash Kumar sen, Shailendra Kumar Bohidar [16] the presented paper signifies separation of liquid and gaseous phases by rotary motion in the cyclone and paper gives the idea of centrifugal force drag force in cyclone technology. Adhesion of particle in secondary air flow by Vladas Vekteris, Vytautas Striška, Vadim Mokšin Darius Ozarovskis [17] presented a clear idea of increase in efficiency of cyclone by giving secondary air flow to the cyclone. By secondary air flow dust will adhere to itself and it fall down so that it can collect 99.99% of 1 micron particle. CFD modeling of cyclone Separator Validation against plant hydraulic performance by Matthew Brannen, Peter Holtham, Mangododdy Narasimha [18] this paper gives CFD result of liquid and gas separation in cyclone separator. Design for high efficiency cyclone for Tiny Industry by Nikhi gopani and Akshay bhargav [19] gives a clear data collection of cyclone, calculation, design of cyclone. Study of Cyclone and Study of its Performance parameters by Mahesh R Jadhav presented the Idea of velocity distribution around cyclone by CFD analysis. The Effect of Vertex finder in pressure drop in cyclone separator by Ferit Fecici, Vedat ari and Murat kapsiz [20] presented paper signifies calculation of pressure drop in cyclone. Studies and Research on cyclone Separator: Review by Sunil J Kulakarni and Nilesh L Shinde [21] signifies how Cyclone more efficient then other separators.

3. Conclusion

From detail review of paper clearly signifies Cyclone separator is suitable technology to implement based on easy of implementation and economic point of view. But to separate small micron dust cyclone alone is 99% Efficient. But A Two set of cyclones with filters is designed such way that in one cycle one cyclone with filter is activated. A Flow control valve is used to control direction of air. In second cycle second set of cyclone and filter is activated such that A filtered air is sprayed to first set which clean the filter. In this way cycle is repeated and regeneration of air is possible and consequently it removes the manual cleaning of filters.

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