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# Review on Pneumatic conveying system in thermal power plant

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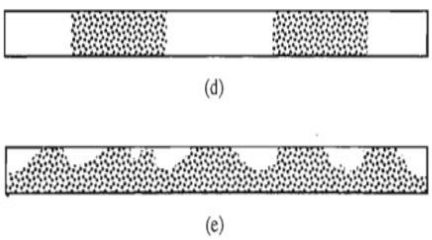
**Abstract**

As per the living standard electricity is most import energy source which is necessary to fulfil the basic requirement in daily life of human beings. In India coal based thermal power plant are the basic mean for electricity generation .After combustion of coal fly ash is the residue in various hoppers of power plant and it necessary to handle the fly ash in such way that it should not affect the performance of the thermal power plant. There are various ways to handle the fly ash in power plant but the pneumatic conveying system is the best option of ash handling but there are certain factors which effect the flow of ash through the conveying line which results in choking of line and over flow of hoppers. The explain the various factors influence the conveying system and the basic strategy to solve the existing problem.

## 1.0 INTRODUCTION

Pneumatic conveying is being used increasingly in industry to convey a various grades of dry fly ash. Various efforts have been made to advance the research and the application of pneumatic ash conveying system. Experience has demonstrated that pneumatic conveying exhibits different performances and flow patterns for different air mass flow rates ($m_f$). There are many ways of describing the different flow patterns. Among them, the concept of the phase diagram. By using the phase diagram, the flow patterns can be determined within a pipeline for a given set of conveying conditions. According to the different flow patterns, pneumatíc conveying is classified primary as dilute phase or dense phase.

Dilute phase conveying in general employs large volumes of air at high velocity so that the individual particles are conveyed as a fully suspended flow, as shown in Figure 1.1(a). If the mass flow ratio (m*), which is a ratio of the dry fly ash mass flow rate ($m_{df}$) to the conveying air mass flow rate ($m_f$)., is in the range 0 <m*< 15, then the mode of flow usually is regarded as dilute phase conveying. [17]



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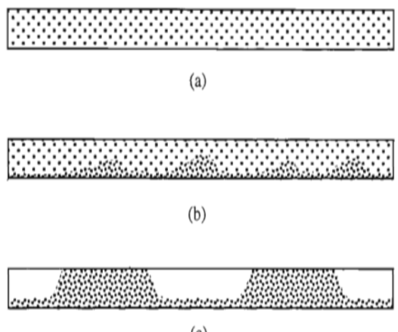

Fig:1.1 Flow pattern in pneumatic conveying in horizontal pipe

Dense phase conveying is defined by Konrad et al. as the conveying of particles by air along a pipe that is filled with particles at one or more cross-sections, as shown in Figure 1.2(c), (d) and (e). The flow pattern and behaviour of dense phase conveying are much more complex than those of dilute phase conveying so that there is, as yet, no universally accepted definition for dense phase conveying. Some researchers define dense phase conveying when mass flow ratio m* > 15. The different types of dense-phase shown in Figure 1.1(c), (d) and (e) are dependent on the material and method of conveying. The conveying that has flow patters shown in Figure 1.1(c) and (d) is defined in this thesis as dense phase low-velocity pneumatic conveying. Figure 1.1(c) shows the slug flow of fine and coarse granular products (e.g. wheat, semolina) displaying natural slugging ability and Figure 1.1(d) shows the plug flow of more cohesive-type products (e.g. milk powder), The conveying shown in Figure 1.1 (e) is called fluidised dense phase conveying, which is achieved usually with powders, such as cement, pulverised coal and fly ash. Besides dilute and dense phase conveying, for some products, there is an unstable dune flow between dilute and dense phase flow, as shown in Figure 1.1(b), where the occasional "dune" may grow to fill the pipe and cause temporary blockage and severe pipe vibrations. To achieve reliable pneumatic conveying, this unstable zone should be avoided. Dilute phase conveying is most widely used in industry. Only in the last 2-3 decades, there has been increasing interest in low-velocity dense phase pneumatic conveying due to the following reasons.

- Less amount of air is needed to convey the dry fly ash particles. This can be important if an expensive gas needs to be used for some reason, e.g. nitrogen to convey explosive powders.
- Particle velocity is able to be controlled in the range 0.25 to 5 $m^{-1}$ (depending on degradation and/or throughput requirements), and as a result, damage to the product (e.g. particle attrition or scratching) is minimised or even eliminated. Also pipe/bend wear is reduced dramatically.
- Only small filtration systems are required, due to the relatively low amounts of air used for conveying the dry fly ash.
- Material is transported at extremely high levels of volumetric concentration, which are not possible in conventional-type systems. Hence, reasonable conveying rates are obtained despite the relatively low velocities that are used for conveying the dry fly ash.
- A lower specific power consumption is needed.
- Electrostatic charging of the particles is reduced by using dense phase.

Certainly dense phase pneumatic conveying systems also have some disadvantages, such as:

- The precise mechanism by which the particles are conveyed has not yet been well understood, leading to anomalies in system performance, difficulties in design and to the danger of unforeseen pipe blockages.
- They cannot provide "pure" continuous conveying due to the slugging or plugging mode of flow. Although some commercial systems have been developed successfully to overcome the above disadvantages, e.g. using a bypass pipe to convey conventionally difficult materials such as alumina, up till now the research for dense phase pneumatic conveying is still at an elementary stage. In particular, the pressure drop of dense phase conveying systems still cannot be predicted accurately. Hence, the ultimate objective of this research is to investigate and develop a model for the prediction of pipeline pressure drop so as to provide a reliable design strategy for dense phase pneumatic conveying systems. It should be pointed out that this research is confined to horizontal low-velocity slug flow pneumatic conveying, as it appears currently to be the most attractive and widely applicable mode of conveying the dry fly ash in industry (e.g. cement, power industries).

2.0 Generation of fly as in year 2016-2017 in India

In India mostly thermal power plants are involved in electricity generation and the fuel used by the thermal power is coal of various grades and the residual product obtain after the combustion is various typed of fly ash. Haque[1] discussed the production and cosumption fly ash. Jala and Goyal discussed the complete process of thermal power plant and the area where ash get collect. In discussion they explained that The combustion of powdered coal in thermal power plants produces fly ash. The high temperature of burning coal turns the clay minerals present in the coal powder into fused fine particles mainly comprising of aluminum silicate. Fly ash produced thus possesses both ceramic and pozolanic properties. When pulverized coal is burnt to generate heat, the residue contains 80 percent fly ash and 20 percent bottom ash. The ash is carried away by flue gas collected at economizer, air pre-heater and ESP hoppers. Clinker type ash collected in the water-impounded hopper below the boilers is called bottom ash. Flash being a coal combustion residue shows a wide variation in their physic-chemical and mineralogical properties depending on the nature of parent coal, conditions of combustion, type of emission control devices, storage and handling methods. CAE New Delhi 2017 [2] reported that in 2016-2017 Fly ash generation & utilization data for the Year 2016-17 (April 2016 to March 2017) has been received from 155 (One hundred fifty-five) coal/lignite based thermal power stations of various power utilities in the country. The table below will give the summary of fly ash generation and utilization during year 2016-2017. In the Figure:3 report it is shown that the total no of thermal power in 18 states are of 155 and the generation of fly ash was in these stated during the year 2016-2017 was 169.2533 million tonne as a result of 157377 MW generation of electricity and the utilization of fly ash during the session 2016-2017 was about 107.0956 million tonne

| Description | | Year 2016-17 |
|---|---|---|
| • Nos. of Thermal Power Stations from which data was received | : | 155 |
| • Installed capacity (MW) | : | 157377.00 |
| • Coal consumed (Million tons) | : | 509.46 |
| • Fly Ash Generation (Million tons) | : | 169.25 |
| • Fly Ash Utilization (Million tons) | : | 107.10 |
| • Percentage Utilization | : | 63.28 |
| • Percentage Average Ash Content (%) | : | 33.22 |

Figure:2 Fly ash generation year 2016-2017

| Sl. No. | Name of State | Nos. of TPS | Installed Capacity (MW) | Fly Ash Generation (Million-tonne) | Fly Ash Utilization (Million-tonne) | Percentage Utilization % |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | ANDHARAPRADESH | 10 | 10972.50 | 17.8322 | 12.6832 | 71.13 |
| 2 | ASSAM | 1 | 250.00 | 0.2070 | 0.0000 | 0.00 |
| 3 | BIHAR | 4 | 4100.00 | 7.3916 | 2.3929 | 32.37 |
| 4 | CHHATISGARH | 20 | 17740.00 | 25.1658 | 10.8393 | 43.07 |
| 5 | DELHI | 2 | 840.00 | 0.3650 | 0.5720 | 156.71 |
| 6 | GUJARAT | 11 | 15472.00 | 3.4842 | 3.5465 | 101.79 |
| 7 | HARYANA | 5 | 5550.00 | 4.1413 | 5.2922 | 127.79 |
| 8 | JHARKHAND | 7 | 5612.50 | 6.7453 | 7.2876 | 108.04 |
| 9 | KARNATAKA | 4 | 5480.00 | 3.0739 | 1.7080 | 55.56 |
| 10 | MADHYA PRADESH | 7 | 10640.00 | 11.4186 | 4.1064 | 35.96 |
| 11 | MAHARASHTRA | 20 | 21556.00 | 16.4984 | 11.7649 | 71.31 |
| 12 | ODISHA | 5 | 5188.00 | 11.4560 | 6.3975 | 55.84 |
| 13 | PUNJAB | 3 | 2640.00 | 0.8799 | 1.4296 | 162.48 |
| 14 | RAJASTHAN | 8 | 7840.00 | 6.7657 | 6.4489 | 95.32 |
| 15 | TAMILNADU | 10 | 8430.00 | 6.1763 | 4.6297 | 74.96 |
| 16 | TELANGANA | 3 | 1820.00 | 2.6751 | 0.9652 | 36.08 |
| 17 | UTTAR PRADESH | 18 | 19104.00 | 28.2732 | 13.2480 | 46.86 |
| 18 | WEST BENGAL | 17 | 14142.00 | 16.7039 | 13.7837 | 82.52 |
| | **GRAND TOTAL** | **155** | **157377.00** | **169.2533** | **107.0956** | **63.2754** |

Figure:2 Fly ash generation year 2016-2017

### 3.0 Fly ash handling method

Huge amount of fly ash is generate from the thermal power plants and it is necessary to handle it in a perfect manner with various arrangements.(Khambekar & Barnum, 2012)[3] described the various options to handle fly ash reliably in a desecrated mode as well as in a fluidized state. In the it explained the complete procedure of handling of fly ash in precipitator or bag house hoppers as well as in storage silos. In a typical fly ash handling system, the material that is generated as a result of combustion is captured by an electrostatic precipitator (ESP) or a bag house before the flue gases reach the stack. These ESPs and bag houses generally have multiple pyramidal hoppers at the bottom, in which the ash is collected by gravity and then is transferred to a storage silo.

These storage silos generally have provisions for a truck load-out to carry the fly ash for disposal or reuse. As a result of the frictional nature and fine particle size distribution, fly ash handling systems often experience problems if they are designed without following a prudent engineering approach. In the following, we first describe the common flow problems that can occur when handling and storing fine dry fly ash. As a fine powder, fly ash can behave like a fluid when sufficient air is present. Flooding can result, particularly when the handling rate is too high to allow sufficient time for the entrained air to escape.

### 3.1 Wet ash handling system

(Power engineering international 2010)[4] demonstrated the wet ash condition and method to handle it in the article reported that traditionally, bottom ash has been handled in a wet condition via established technologies such as impounded hoppers or submerged scraper conveyors (SSC). The use of water as opposed to air as a cooling agent can incur additional costs. Factors such as water treatment, corrosion damages, higher disposal costs and environmental problems, as well as the higher costs to maintain must all be considered.

### 3.2 Dry ash handling system

(Power engineering international 2010)[4] also demonstrated the dry ash it was reported that using a dry system means that no water is required in the process, therefore no water treatment is necessary. Reduced emissions and returning heat energy to the boiler resulting in lower coal usage and so with lower costs for emission trading are also highly beneficial to

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plant operators. The table below shows the main factors which compare between the two methods of conveying.

### 4.0 Pneumatic conveying system and it classification

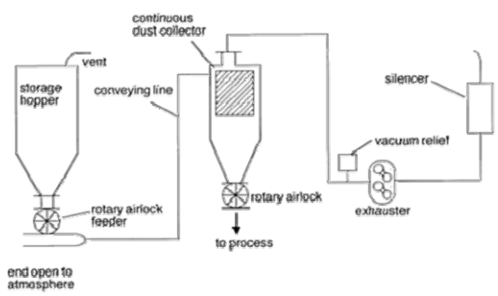
In fuel handing system there are various types of system are involved but among them pneumatic conveying is the best way to handle the fly ash for long distance in short time and at minimum cost and space.(A.Bhatia)[6] explained the complete Pneumatic conveying system and its classification in its article in which pneumatic conveying system defined as a process by which bulk materials of almost any type are transferred or injected using a gas flow as the conveying medium from one or more sources to one or more destinations. Air is the most commonly used gas, but may not be selected for use with reactive materials and/or where there is a threat of dust explosions. In the article it is reported that Pneumatic conveying can be used for particles ranging from fine powders to pellets and bulk densities of 16 to 3200 kg/m3 (1 to 200 lb/ft3 ). As a general rule, pneumatic conveying will work for particles up to 2 inches in diameter @ typical density. By "typical density" we mean that a 2 inch particle of a polymer resin can be moved via pneumatic conveying, but a 2 inch lead ball would not. dilute phase, dense phase, and air conveying. 1. Dilute-phase conveying is the process of pushing or pulling air-suspended materials from one location to another by maintaining a sufficient airstream velocity. Dilute phase conveying is essentially a continuous process, characterized by high velocity, low pressure and low product to air ratio.

2. Dense-phase conveying relies on a pulse of air to force a slug of material from one location to another. Dense-phase system is essentially a batch process, characterized by low velocity, high pressure and high product to air ratio unlike dilute phase which is a low product to air ratio.

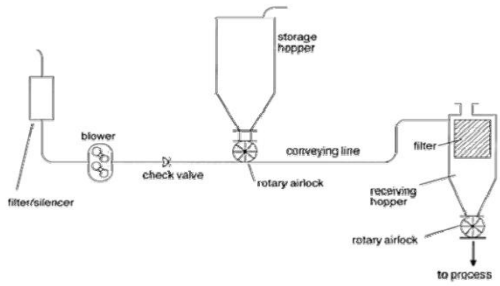
3. Air-activated gravity conveying is a means of moving product along a conveyor on a cushion of air.

### 4.1 Dilute phase pneumatic conveying system

(Peter Wypych 2001)[7] represent the problem and solution in dilute phase pneumatic conveying system. Dilute-phase pneumatic conveying (suspension-flow) has been in existence for over 100 years. During this time, many of the “obvious” or “expected” problems have been identified and addressed/solved. For example:




Dilute phase transport: negative pressure system




Dilute phase transport positive pressure system

Figure:4 Dilute phase positive and negative transport system

(1) improved test-design procedures, reducing air flow and power consumption;

(2) more efficient operation, reducing transport velocities, high rates of wear and product damage;

(3) developments in abrasion-/impact-resistant materials, extending the service life of pipes/bends. However, there are numerous (existing or potential) problems that are not so obvious to the designers, users, and even researchers of dilute-phase pneumatic conveying technology. Some of the major issues include:

(i) higher rates of gas expansion in negative-pressure conveying (i.e. with respect to “equivalent” positive-pressure systems);

(ii) rotary valve feeding characteristics (e.g. venting effects, interfacing with pipeline, deposition problems);

(iii) predicting minimum conveying velocity for different products, conveying rates and pipe diameters (e.g. localized deposition, effect of feeding method and prime mover, subjectivity in identifying and defining saltation conditions);

### 4.2 Dense phase pneumatic system

(K.Konrad 1986)[10] This review focuses on : horizontal and vertical conveying, the use of phase diagrams, choking and the suitability of powders for dense phase conveying, and the pressure drop required to move a plug through a pipeline as a function of plug length . (Note : A plug is a length of bulk solids that occupies the full cross-section of the pipeline.) After that, some photographs of the observed flow patterns are described and discussed. This is followed by a brief description of a theoretical model for horizontal plug conveying and, finally, by conclusions and suggestions for further work .In the futher work author suggested following things which include:

(i) The conveying of fine cohesive materials.

(ii) Modification of the Wen and Simons correlation to account for the large changes in gas density in long pipes .
(iii) A set of experiments similar to those of Dickson et al and Lilly , who measured the pressure drop required to sustain the movement of a plug in a horizontal pipe . The work would

include the measurement of all the particle properties (Ps, P B, 0, (w , d, c, c v), the use of some cohesive materials and both horizontal and vertical pipes . The results could then be compared with the theory of Konrad et al.
(iv) An experimental and theoretical study of vertical plug conveying with particular emphasis on the rise velocity of the square nosed slugs observed.
(v) An experimental investigation of the validity of the modified Smith criterion for predicting the transition from bubbling to slugging, etc .
(vi) A short study on phase diagrams . In particular, in the region of the minima in the curves of constant mass flow rate of solids .
(vii) Using photography, to document all the possible flow patterns in both horizontal and vertical pipes .

## 5.0 Parameter effecting pneumatic conveying system

### 5.1 Pipe length

(DUAN Guangbin et al 2010) [11] Investigated the energy consumption of gas solid two phase flow,a 1:1 test bench for the pneumatic conveying system was set up. Gas-solid two-phase flow experiments of fly ash were carried out with compressed air being adopted as dynamic force. Groups of GP/DP transmitters were installed along the pipeline. Pressure drop along the pipeline was expressed by the GP values. So the energy consumption can be achieved by the given experimental data. The effect of the solids loading ratio, pneumatic conveying pressure, gas velocity and pipeline arrangement etc on the energy consumption were performed according to the experiments. In the result it was concluded that:
(1) The solids loading ratio, conveying pressure, gas velocity, pipeline length and layout, power equipment and solids properties had noticeable effect on the energy consumption along the pneumatic conveying system.
(2) In the design of pneumatic conveying system, transportation stable must be paid more attention to.
(S. M. El-Behery 2016) [12] In the investigation gas-solid flow in vertical pneumatic conveyor is numerically simulated using a steady state one dimensional two-fluid model. The model was validated against experimental data and two dimensional Eulerian-Lagrangian simulations. The comparisons showed that the model is capable of predicting the pressure drop in vertical pneumatic conveyor with a good accuracy. In addition, the model predicted the linear variation of pressure with mass loading ratio very well. It was also found that the pressure drop increases as the solid mass flow rate, particle diameter, and particle density increase. The transition from dense phase to dilute phase occurs at the point of minimum pressure drop. The predicted minimum pressure drop velocity was compared to experimental measurements for a wide range of operating conditions, and a good

agreement was obtained. The velocity at minimum pressure drop increases as the solid mass flow rate, particle diameter, and particle density increases and decreases as the system total pressure increases.
(Qingliang Guan 2017)[16] Dense-phase pneumatic conveying of a high-volatile bituminous coal powder was carried out in an experimental facility using 25, 15, and 10 mm pipes and at back pressures of 1.0–4.0 MPag. The conveying characteristics and the influencing mechanism of operating parameters and structure parameters were studied. Pressure drop models for horizontal pipes and vertical upward pipes were established. The indicator and criterion for stable conveying were proposed, and the effect of operating parameters on the conveying stability was systematically analyzed.
Solid flow rate improved with increasing total differential pressure or decreasing conveying distance since pressure drop per unit length increased. Solid flow rate increased with pipe diameter at a constant total differential pressure.
The stability of vessel pressure could affect the stability of conveying. The fluctuation of solid flow rate was mainly caused by the fluctuation of solid concentration. No obvious effects of solid loading ration and back pressure on conveying stability were observed. There was a trend that conveying stability increased as superficial gas velocity decreased. When superficial gas velocity was lower than ~6 m/s for 25 mm pipes or 8 m/s for 15 mm pipes, unstable conveying might occur with average fluctuation amplitude of solid flow rate larger than 7%.

### 5.2 Particle size

(Jia-Wei Zhou 2017)[17] influence of the particle shape and flow regime on the lump coal breakage in pneumatic conveying using CFD-DEM simulation. A variety of agglomerates with different sphericities were modelled by the parallel bond method to analyse the breakage characteristics of lump coal. The numerical parameters, simulation conditions and CFD-DEM simulation results were separately validated by experimentation. To demonstrate the lump coal breakage process, the mechanism energy variation in the coal agglomerate was analysed. The following conclusion were drawn as after the analysis.
(1) The non-sphere agglomerates are more likely to be broken in the same conditions. The higher the sphericity, the higher the particle agglomerate integrality ratio. The Exp3p2 exponential function can fit the variation of the numerical simulations with less than 2% fitting errors.

(2) A quasi-periodical downgrade of the sphere agglomerates integrality ratio is observed in the swirling flow. Additionally, the sphere coal agglomerates the integrality ratio continuously increases with the swirling intensity. The integrality ratio is maintained at approximately 0.975 at 30 D position for S = 0.3958. The Exp3p2 exponential function perfectly regressed the sphere coal agglomerates integrality ratio and swirling number in this study.

**5.3 Particle shape**

(James E. HILTON 2009)[19]In the study it was investigated the role of particle shape in pneumatic conveying system. In the analysis simulations have shown that altering the shape of a particle by a small amount can significantly affect the bulk dynamics of a pneumatic conveying system. The change in shape of a particle causes the packing fraction to change, altering the bulk density of the particle bed. This, in turn, alters the fluidisation velocity and can cause slugs to become unstable. This has been confirmed using Dixon's method, which has not previously been used for shaped particles. Simply applying expressions derived from empirical relations for spherical particles may not give a correct prediction of a pneumatic flow mode. Particle shape should therefore be taken into account in the consideration and design of these systems.

**5.4 Particle density**

(S. M. El-Behery 2016) [12] In the investigation gas-solid flow in vertical pneumatic conveyor is numerically simulated using a steady state one dimensional two-fluid model. The model was validated against experimental data and two dimensional Eulerian-Lagrangian simulations. The comparisons showed that the model is capable of predicting the pressure drop in vertical pneumatic conveyor with a good accuracy. In addition, the model predicted the linear variation of pressure with mass loading ratio very well. It was also found that the pressure drop increases as the solid particle density increase.

(C.P.Narimatsu 2001)[21]The effects of particle size and density on the fluid dynamic behavior of vertical gas-solid transport of Group D particles in a 53.4 mm diameter transport tube were studied for five types of solids. For the conditions studied, no influence of the physical properties of the particles on the length of entrance region was detected. The mean voidage measured in the transport tube varied from 0.986 to 0.999 under the whole range of operational conditions and did not depend on particle density or diameter. The high voidage values even for dense phase transport indicate that this variable cannot be used alone to characterize a flow regime. All the curves of pressure gradient versus air velocity, however, presented a minimum pressure gradient point, which is associated with a change in the flow regime from dense to dilute phase. Particle size and density affected pressure gradient only for the dense-phase transport region, where pressure gradient increased with increasing particle diameter from 1.00 to 3.68 mm and density from 935 to 2500 kg/m$^3$. In this range particle properties did not seem to be relevant under dilute-phase flow conditions. The transition velocities between dense- and dilute-phase flow increase with increasing particle density and diameter as a result of the greater slip force required to transport heavier and larger particles. The fitted equation for predicting minimum velocities is limited to transport of glass particles in the range of diameters studied.

**6.0 Air pressure**

(Luiz Moreira Gomes 2009)[22]Pressure drop in dilute phase horizontal and vertical pneumatic conveying can be predicted by using a hydrodynamic model. Comparison between the model and the experimental data involved the use of standard drag correlations and the fitting of an inlet void fraction which was not measured. It has been observed that the estimate of initial velocity (or initial porosity) is a parameter that strongly influences the theoretical prediction of pressure distribution and there is no methodology that is able to predict the initial conditions in terms of other parameters involved, such as geometric configuration of the feeding device and empirical correlations for calculating the coefficients of drag and friction (gas-solid and particle-wall) in the inlet flow. Results of numerical analysis for this model, considering different experimental data, demonstrate the ability to obtain accurate predictions of the pressure drop to flow in the horizontal and vertical directions in pneumatic conveying systems. The calculated values are able to explain the physical behavior of the steady-state two-phase transport systems. Therefore, they are suitable to be used as a tool in the design of pneumatic conveying systems.

(Hasan Ghafori 2017)[23] developed new technique that is based on the use of an additional airinjection system in a pipeline to decrease the pressure drop and power consumption has been proposed. Experimental data were used to evaluate the numerical simulation results. The pressure drop and power consumption were predicted and the CFD simulation results agreed qualitatively with the experimental data. The average pressure drop and power consumption for conveying corn and barley in perforated double tube are 4% and 9% less, respectively, than in a flexible pipe.

**7.0 loading ratio**

(Koichiro Ogata 2015)[24]This study experimentally investigated the dense phase pneumatic conveying in a horizontal rectangular channel using the fluidizing air. The powder used the glass beads belongs to Geldart B particle, where the mean particle diameter is 127Pm, the particle density is 2623kg/m3 and the minimum fluidizing velocity is 12.3mm/s. The experimental device consists of a powder discharge vessel, a horizontal rectangular channel at the side of vessel and the air supply section at the bottom of the vessel and the horizontal channel. The powder was fluidized by air through the porous membrane of the air supply section at the bottom of the vessel and the horizontal channel. Then, this system can be conveyed the fluidized powder. As the result,

we confirmed the requirement that the fluidizing air to the bottom of the powder discharge vessel was required to the powder conveying of this system, and that the fluidizing velocity at the bottom of the horizontal channel was larger than that of the minimum fluidizing velocity. This result means that the fluidizing velocity at the bottom of the vessel and the horizontal channel is important to obtain the stable powder conveying. The mass flow rate and solid loading ratio were estimated by the measured data of the mass of transported powder. In addition, these results were compared with the conveying characteristic of the glass beads of 53Pm belongs to Geldart A particle. Then, the mass flow rate of Geldart A particle was higher than that of Geldart B particle. The solid loading ratio of the Geldart A particle was also greatly large to that of Geldart B particle. Therefore, it was considered that the high conveying efficiency to Geldart A particle was obtained, when the dimensionless fluidizing velocities at the bottom of the powder discharge vessel and the horizontal channel were same condition.

**CONCLUSION**

The various literatures demonstrated the impact of various factors in pneumatic conveying system which helped to understand the current scenario of the pneumatic handling system. The review concluded that it is necessary to develop a experimental setup such that in which various factors can be analyse to rectify the existing trouble in fly ash handling system.

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