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A Study on Grouting Material for Various Industrial Applications in Food Processing Plan

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Abstract—*Apply the technical and managerial knowledge in real case scenario of food industry. The goal of the project is to benefit the company & society by the studies of food plant operations Management. It will benefit the production, quality & other department to maintain their seamless alignment and flow and hence overall significance of the study remains the same as stabilizing the system & continuous improvement. Continuous improvement is the need of every industry in every aspect to rise & sustain in today's highly competitive market this requires the regular study of the system, identifying the waste & inefficiency of the system and then in the next step we need to eliminate such waste & bottleneck to create free flow of resources and avoid its wastage or over usage in the system. In this report "A study on grouting material for various industrial applications in food processing plant" we will try to eliminate the excessive usage of the grouting material and also avoid the improper or over usage of the cement and sand mixture in various industrial applications in real time scenario.*

Keyword*: Operation Management, Production, Control, Bottleneck, Continuous Improvement.*

1. INTRODUCTION

These sections have well defined area of job and sequences of activities. Our study is carried out in the same space to improve the efficiency of the system, and the scope of the study always remains broad. The system is well defined in every aspect, including geographical, chronological, conceptual & economical that they made the study very easy & comfortable at every step.

Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly.

In this phase, soft raw materials are first crushed into suitable size. This is done usually in cylindrical ball or tube mills containing the charge of steel balls

In this part, the powdered limestone is mixed with the clay paste in proper proportion (75%=limestone;clay=25%). The mixture is then grounded and made homogeneous by mean of compressed gas. The resulting material is known as slurry having 35-40% water.

Slurry is then introduced in rotary kiln with help of conveyor. The rotary kiln consists of large cylinders 8 to 15 feet in diameter & height of 300-500 feet. It is made with steel & is usually lined inside with firebricks.Kiln rotates at the rate of 1-2 revolution per minute. In rotary kiln, slurry is passed through different zones of temperature. This whole process in kiln usually covers 2 to 3 hours.

The main intension of this survey is to correlate the concepts of mechanical and production engineering in the field of food industry. Here we search of the different types and area of work done for the growth and development the industry.

Vahidoddin Fattahpour(2014). Laboratory investigation of shaft grouting, the results indicate that a target volume of grout can be injected if the grout injection pressure is larger than the total stress by a magnitude at least equal to the effective stress. **Hassan mohammadi golestan(2014), this paper examines the hydraulic features of geological formations of the left abutment of Darband Earth Dam before and after the pumping of grout materials into three boreholes of total length of 270 m. The results of permeability tests showed that the average depth of Lugeon which has been 23 m prior to injection has decreased to less than 2 m after grouting. Hideki Shimada (2014),** the injection experiment was performed under low-pressure on a decomposed granite sample, and considered the influence of the cement/water ratio of the grouting material. The decrease in the discharge rate becomes considerable during the injection experiments when the cement/water ratio is changed from low to high. **Kai Fang (2014)**, a rational approach of predicting the response of the grouted shaft with explicit consideration of end bearing and side friction improvement has been developed in this paper. The results show that the measured response of the shaft lies between the predicted upper and lower bound, which indicates the validity of the approach. **Tomofumi Koyama (2013)** Grouting is commonly used to decrease the hydraulic conductivity of fractured rock masses and control the groundwaterinflow. In this study, to simulate the grout injection process, a three-dimensional numerical modelbased on an equivalent continuum approach was developed and applied to the in situ grout injection tests at the Grimsel test-site, Switzerland.

2. METHODOLOGY

"Proper machine installation is critical in maximizing reliability and minimizing life cycle costs." Machinery generates energy (vibration) that must be either absorbed by the foundation or trapped within the machine. Cross talk, in which energy generated by one machine is transmitted into another machine, is a chronic source of reliability problems. This is especially true in plants having multiple continuous process lines such as paper machines, high-speed printing and metal processing lines.

When a machine is mounted on a concrete pad, the pad should be independent from the surrounding floor. Normally, the pad is formed and poured directly on bedrock and has a very minute separation between it and the surrounding floor to ensure isolation. This allows energies generated by the machine to be absorbed and prevents outside sources of vibration from entering the machine.

When a machine must be mounted directly on the floor, isolation must be accomplished by using springs or elastomeric pads specifically designed to absorb or stop transmission of generated energy. Exercise care when selecting them. Isolators are designed for specific, relatively narrow bands of frequencies (e.g., 18 to 21 Hz) and will not isolate frequencies outside their functional bandwidths. When properly sized and installed, they do a good job of protecting machines from both generated and outside energies sources. Improperly sized or installed, they are absolutely worthless.

In our case we have to perform the grouting installation on the FD fans & ID fans which are used in the boiler system.

Forced Draft Fans

Forced Draft (FD) fans purpose is to provide a positive pressure to a system. This basic concept is used in a wide variety of industries but the term FD Fans is most often found in the boiler industry. Fans for boilers force ambient air into the boiler, typically through a pre heater to increase overall boiler efficiency. Inlet or outlet dampers are used to control and maintain the system pressure. Typical fan arrangements are 3SI or 3DI which utilize a wheel center hung on the shaft with integral inlet boxes.

Induced Draft Fans

The main function of the ID FAN is to suck the flue gases coming out of the furnace via economizer, air heater. Also it maintains the negative draft (pr) inside the boiler e.g. 10mmwc. No. of blades of the peripheral of the hub is 23, with tilting blade angle mechanism and variable frequency drive mechanism for controlling the speed and angle. Next step is their proper grouting which is done by using GP2 grout.

3. PROBLEMS AND DISCUSSION

3.1 Description of Conbextra GP2 Grout

Conbextra GP2(4S) is supplied as a ready to use dry powder. The addition of a controlled amount of clean water produces a free flowing, non-shrink grout for gap thicknesses up to 100mm. Conbextra GP2(4S) is a blend of Portland cement, graded fillers and chemical additives which impart controlled expansion in the plastic state whilst minimizing water demand. The low water demand ensures high early strength. The graded filler is designed to assist uniform mixing and produce a consistent grout.

Used for precision grouting where it is essential to withstand static and dynamic loads. Typical applications would be the grouting of base plates of turbines, compressors, boiler feed pumps etc., and it can also be used for anchoring a wide range of fixings. These include masts, anchor bolts and fence posts.Grout is a construction material used to embed rebars in masonry walls, connect sections of pre-cast concrete, fill voids, and seal joints (like those between tiles). Grout is generally a mixture of water, cement, sand, often color tint, and sometimes fine gravel (if it is being used to fill the cores of concrete blocks). It is applied as a thick emulsion and hardens over time, much like its close relative mortar. Unlike other structural pastes such as plaster or joint compound, grout, when mixed and applied correctly, creates a waterproof seal. Main varieties include: tiling grout(either urethane, cement-based or epoxy), flooring grout, resin grout, non-shrink grout, structural grout and thixotropic grout.Structural grout is often used in reinforced masonry to fill voids in masonry housing reinforcing steel, securing the steel in place and bonding it to the masonry. Non-shrink grout is used beneath metal bearing plates to ensure a consistent bearing surface between the plate and its substrate.

Portland cement-based grouts come in different varieties depending on the particle size of the ground clinker used to make the cement, with a standard size of around 15 microns, micro fine at around 6-10 microns, and ultrafine below 5 microns, with the ability of the final grout to penetrate a fissure largely dependent on this particle size (smaller size equates to greater penetration). Because these grouts depend on the presence of sand for their basic strength, they are often somewhat gritty when finally cured and hardened.

Tiling grout is often used to fill the space between tiles or mosaics, and to secure tile to its base. Although ungrouted mosaics do exist, most have grout between the tesserae. Tiling grout is also cement-based, and comes in sanded as well as unsanded varieties. The sanded variety contains finely ground silica sand; unsanded is finer and produces a non-gritty final surface. They are often enhanced with polymers and/ or latex.

Table 1: Different samples ratios

Type	Grout Ratio	Cement Ratio	Sand Ratio
A	1	1	4
B	1	2	6
C	1	3	6
D	1	3	4

Fig. 1: Specimens of grout in different ratio

Table 2: Specimens comparison in terms of %

Type	Grout %Age	Cement %Age	Sand %Age
A	17	17	68
B	11	22	67
C	10	30	60
D	13	39	52

Before we begin to discuss the properties of the mixture samples made it is also very necessary to know the individual properties of the binding material grout and sand let us discuss them in detail one by one. For this we make pure samples of grout and cement and do their comparative study.

Grout: The sample is prepared by mixing grout and water approximately in the ratio 5:1 and then the sample is allowed for drying by adequate time in open atmosphere for at least a minimum period of 28 days, the properties measured are:

Compressive strength	63.40 N/mm2
Flexural strength	8.80 N/mm2
Tensile strength	3.20 N/mm2

Cement: The sample is prepared by mixing cement and water approximately in the ratio 5:1 and then the sample is allowed for drying by adequate time in open atmosphere for at least a minimum period of 28 days or more, the properties measured are:

Compressive strength	41.60 N/mm2
Flexural strength	5.10 N/mm2
Tensile strength	1.80 N/mm2

Compressive strength is often measured on a universal testing machine, this range from very small table-top systems to ones with over 53 MNcapacities. Measurements of compressive strength are affected by the specific test method and conditions of measurement. Compressive strengths are usually reported in relationship to a specific technical standard.

A Stress–strain curve is plotted by the instrument and would look similar to the following:

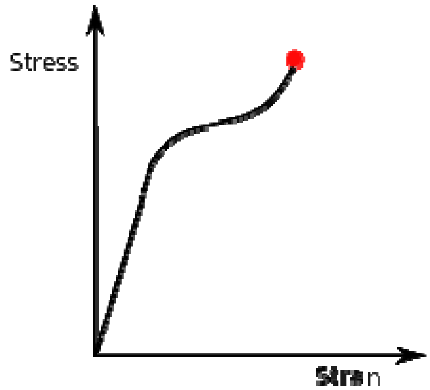

Fig. 3: Stress strain curve for an ideal Specimen

Specimen A: This contains grout, cement & sand in the ratio of 1:1:4.

Compressive strength	44.60 N/mm^2

Specimen B: This contains grout, cement & sand in the ratio of 1:2:6.

Compressive strength	52.30 N/mm^2

Specimen C: This contains grout, cement & sand in the ratio of 1:3:6.

Compressive strength	51.10 N/mm^2

Specimen D: This contains grout, cement & sand in the ratio of 1:3:4.

Compressive strength	58.30 N/mm^2

By the comparison of the below charts which shows the mechanical properties of grout and cement we can easily conclude the all the properties are superior in the grout especially the compressive strength which is the most desirable quality in case of the machines beds. The compressive strength of pure grout is almost 1.52 times higher than the cement.

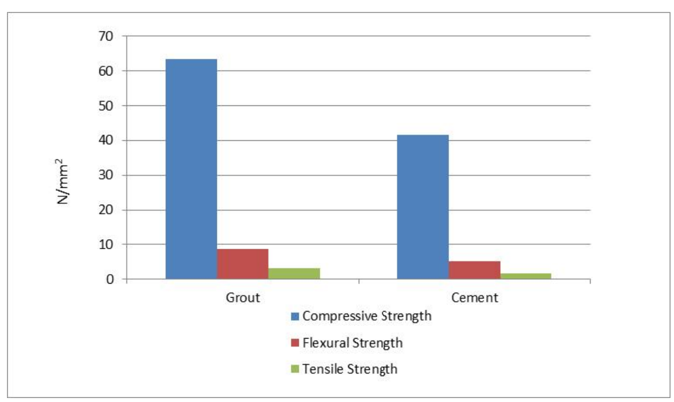

Fig. 4: Comparison of mechanical properties of grout and cement.

The qualitative comparison for all the specimens A, B, C & D is done in the below graph.

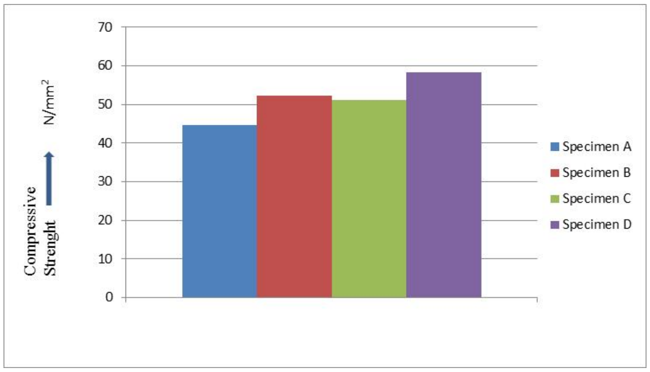

Fig. 5: Comparison of Compressive strength of the different specimens

This shows that the specimen A has the least compressive strength i.e. 44.60 N/mm^2 and specimen D has the highest compressive strength of 58.30 N/mm^2. Here the main emphasis must be given on the specimens B &C; the compressive strength of B is 52.30 N/mm^2 which is higher than that of C 51.10 N/mm^2 only by addition of 1% of extra grout in the mixture.

Also it is observed that even though the quantity of cement in specimen C is 6% more than that of B and also the quantity of sand in the specimen C is 7% less than that of B but still the specimen B has more compressive strength.

To understand this even more better let us do the cost analysis of all the specimens A, B, C & D as organizational goals are always to achieve the desired strength in the most economical way or in other words we can say that the strength and money are the two main governing factors.

The cost of 25kgs grout is Rs 900. So the cost of 1kg grout is Rs 36

The cost of 50kgs cement is Rs 300. So the cost of 1kg cement is Rs 6

The cost of 25kgs sand is Rs 50. So the csot of 1kg sand is Rs 2

This suggests that the cost of 1 unit or grout is 6 times more than that cement and the cost of sand is 3 times less than cement i.e. the ratio of cost of grout : cement : sand is 6 : 1 : 0.33.

The overall cost of specimen A in which the proportions are 17%, 17%, 68%

Is (17*6) + (17*1) + (68/3) = 141.66 units ~ 142 units.

Similarly, overall cost of specimen B in which the proportions are 11%, 22%, 67%.

Is (11*6) + (22*1) + (67/3) = 110.33 units ~ 110 units.

Similarly, overall cost of specimen C in which the proportions are 10%, 30%, 60%

Is (10*6) + (30*1) + (60/3) = 110 units.

Similarly, overall cost of specimen D in which the proportions are 13%, 39%, 52%

Is (13*6) + (39*1) + (52/3) = 134.33 units ~ 134 units.

Let us plot these results on a graph:

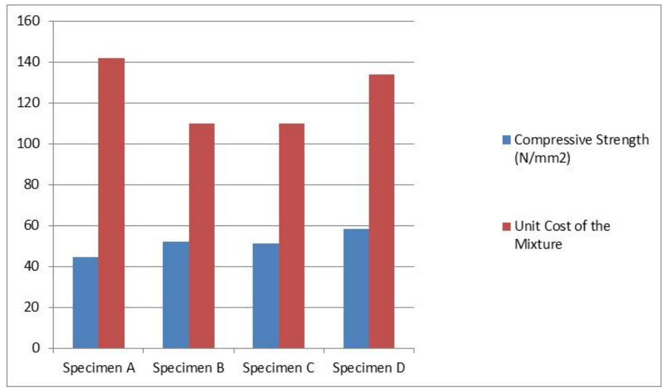

Fig. 3: Comparison of strength and cost of samples

Specimen A though it has the maximum amount of grout 17% but have the least strength of 44.60 N/mm^2 due to the presence of less amount of binding material cement and presence of sand in excessive quantity. Also its unit cost it highest 142 which illustrate that this mixture is week in both the aspects of strength and economy.

Specimen B has comparatively the best strength of 52.30 N/mm^2 at the expense of the least cost per unit that is 110.33 ~ 110 which is equal to the unit cost of specimen C by which we can conclude that it is the best specimen in both aspect of strength and economy.

Specimen C has the strength of 51.10 N/mm^2 which is little less than that of B by (52.30 N/mm^2 – 51.10 N/mm^2) 1.20 N/mm^2 but the unit cost of both the specimen C & B are same thereby we can suggest that when both specimen cost is equal it is always right to select the mixing proportion of 1 : 2 : 6 of specimen B instead of the ratio 1 : 3 : 6 of specimen C.

Specimen D has the highest compressive strength of 58.30 N/mm^2 in all the samples at a moderate cost of 134 per unit mixture which implies that when the strength is of more relevance than the cost we should opt for the mixing proportion of 1 : 3 : 4 which gives best strength.

4. CONCLUSION

This present report deals with the study of various specimen of grout, cement & sand mixed in different proportions to know their strength also their cost analysis has been done.Its industrial relevance is that we should avoid the usage of the mixture which gives poor strength and costs more thereby helping us to do cost reduction without compromising on strength rather it is observed that by selecting the right mixing ratio gives us more strength and is also economical.

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