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Quality Assessment of Sarbottam Cement of Nepal

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Abstract

The quality is ensured for operational competitiveness. Sarbottam Cement has been selected and the objective of the research to analyze the variations in quality parameters of Sarbottam cement and to compare its strength with other cement brands. The nature of the research is Ex-post facto case based experimental research.Lab test for compressive strength, soundness test, setting time test and chemical test were also performed regarding the study of quality parameters. In quality parameters strength at various days (3 days, 7 days and 28), Setting time test, Chemical content (MgO and sulphate content) are found. Then they are depicted and analyzed via Control Charts. For the strength comparison, 3 popular cement was selected and their strength with the Sarbottam cement was checked. For this private lab was selected and cross check for the results were performed by testing the same sample in the Laboratory of Department of Roads under government. Various field test were performed.

Quality parameters were found to be consistent within limit of mean chart of 6 months. the strength of all the cement tested fulfilled the criteria provided by Nepal Standards though higher values were of Sarbottam. During field test, 3 bags ware found without printed date of manufacturing, 2 bags had warm temperature inside bag and 1 bag with lump. 1 bag had warm temperature despite having date of manufacturing printed. 1 bags having smell of earth didn’t have warm temperature or lump. It also had date of Manufacturing. The overall measured parameters of quality are consistent during the period though it should be improved as to be competitive Zero defectives is most.

Keywords: Mean Control Charts, Field test, chemical properties, Physical Properties

INTRODUCTION

1.1 Background

Cement is the second most consumed substance in the world after water(Noche and Elhasia, 2013). Cement is most important material for construction Manufacturing . It is used almost in every construction. Although Nepal is not developed country and lots of development activities are going on and the demand of cement is growing day by day be it for buildings, bridge, road or hydropower project. Nepalese cement industries are continuously thriving to meet the demand of cement. To succeed an Manufacturing or organization the product should be liked by the people. It should attract consumer in order to get good market share but the immediate and serious question arises, is what attracts the customers is the quality of cement. the quality and its consistency in the variation is another key factor which attract the customers. Quality of cement is very essential for quality construction process. Nepal Bureau of Standard Measures (NBSM) monitors the quality related provisions of cement. Currently, there is no any grading system prevalent for cement in Nepal but as per the specifications provided in NS 49, the required values of the parameter resemble to the 33 grade specifications provided by IS 269. The cost of cement is very crucial for the effective construction of any project. Magnesia oxide, insoluble residue, setting time and compressive strength properties were found to be different as claimed by the manufacturer in their cement certificates(Mishra and Chaudhary,2018). This is one of the serious issues that cement Manufacturing is facing as most of the specifications of project require the use of higher-grade cement like 43 grade OPC and 53 grade OPC. Similarly, the variations of strengths and quality of cement with each day's production is also very much important for the cement Manufacturing as every construction project selects the cement of such Manufacturing which has minimal variation in the quality of cement. Sarbottom cement is a newly introduced cement manufacturer in 2010 with its head office at Neupane Tower, Subidhanagar, Teenkune, Kathmandu while manufacturing is located in Nawalparasi district.

1.2 Rational of the Research

Currently, Quality is highly focused even Value management seems to be applied in Project Management (Mishra,2019). Quality of every component of construction including High Density Polyethylene Pipes to all is focused (Mishra and Yadav, 2018). Contractors are strong in terms human resource in Nepal (Mishra, 2018). For big picture , it is time to go for zero defects by maintaining high quality during manufacturing. In case of cement even handling behavior is highly important(Mishra and Chaudhary) It is important for kaizen to know if the Sarbottam cement Manufacturing of Nepal is capable to produce quality cement with minimum variations in strength. How the strength of Sarbottam Cement differs from Other Popular Cement brand of cement Manufacturing is tried to be understood by the study so the users and retailers can be transparent about the Sarbottam cement.

1.3. Research Objective

The objective of the research is to analyze the variations in quality parameters to position Sarbottam cement in response to other Popular Cement manufacturer of Nepal.

LITERATURE REVIEW

Cement must be fine, set in the required time, and must not broaden the volume in order to obtain the high hardening and resistance quality of concrete (Neville,2013).

2.1 Manufacturing of Cement

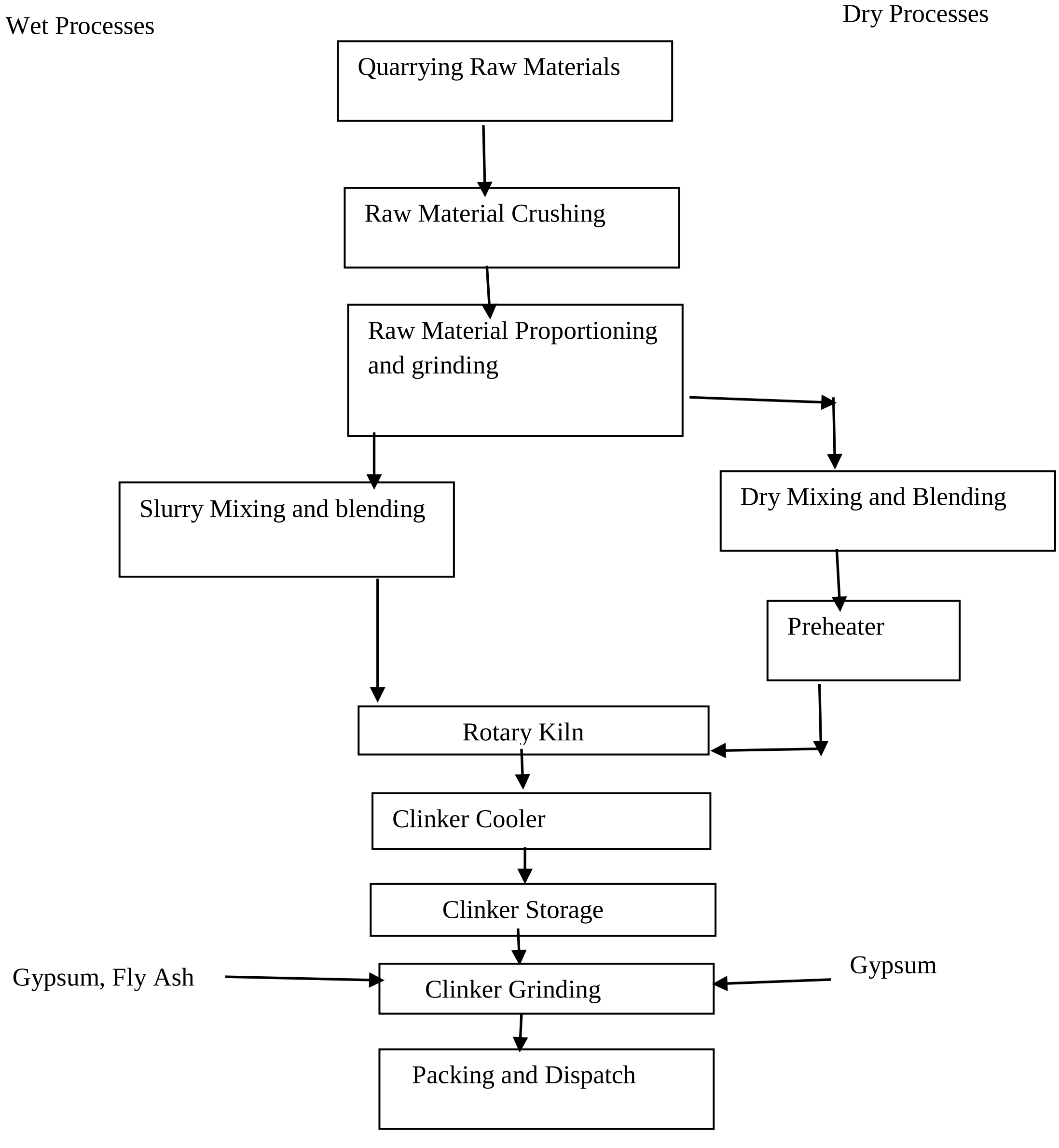


Figure 2.1 Flow Diagram of cement manufacturing process

Cement is manufactured from calcareous material, such as limestone or chalk, and of silica and alumina found as clay or shale. Manufacturing consists of grinding the raw materials into very fine powder, mixing them in suitable proportions and burning them in a large rotary kiln at a temperature of about 1400 degree centigrade when the material melts and partially fuses into clinker. The clinker is cooled and after that it is ground to a fine powder, along with the addition of some gypsum, a resulting the product as the commercial Portland cement used throughout the world (Neville, 2013).

The raw materials can be mixed and ground either in water or in a dry condition; hence giving the names wet and dry process. The mixture is fed into a rotary kiln. The kiln is slightly inclined. The mixture is fed at the upper end while pulverized coal is blown in by an air blast at the lower end of the kiln. When the mixture of raw materials moves down the kiln, it is progressively subjected to higher temperature as a result of which various chemical changes take place along the kiln: First being the water driven off and CO2 is liberated from calcium carbonate. After Passing through a series of chemical reactions in the kiln, 20 to 30 percent of the dry material becomes liquid, and lime, silica and alumina recombine (Gharpedia, 2018). The compounds are fused into balls of 3 to 25 mm in diameter and is known as clinker. Afterwards, the clinker drops into coolers. The cool clinker, which is very hard, is interground with gypsum in order to prevent flash setting of the cement. The ground material is cement. The cement can be manufactured by dry process as well as wet process. In wet process, ground raw materials are mixed with water and are converted into slurry before burning in rotary kiln.

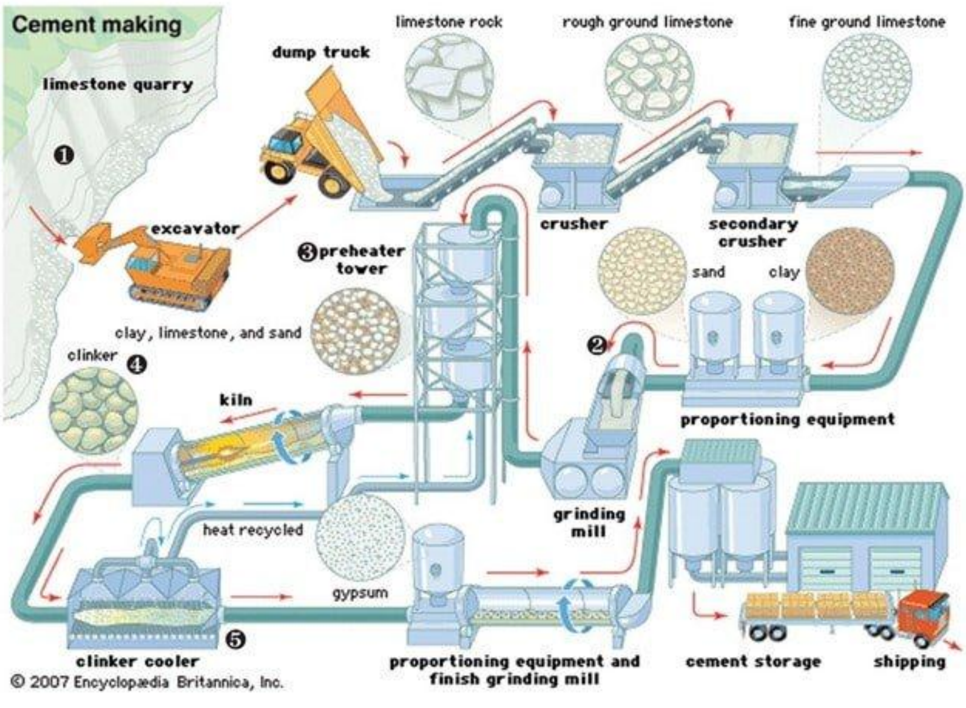


Figure 2.2 Manufacturing process of cement (adopted from civildigital.com)

.2.11 Chemical and Physical Characteristics of cement

Table 2.3: Chemical and physical Characteristics of Cement

S.N	Characteristics	As Per 33 Grade (NS: 49:2041)/ (IS: 269:1989)	As Per 43 Grade (IS: 8112:1989)	As Per 53 Grade (IS: 12269:1987)
A.	**Chemical Characteristics**			
1	LSF (Lime Saturation factor)	0.66-1.02	0.66-1.02	0.66-1.02
2	AM (Alumina Modulus)	0.66 (min.)	0.66 (min.)	0.66 (min.)
3	Insoluble residue (% Mass)	2% (max)	2% (max)	2% (max)
4	Magnesia (% Mass)	5% (max)	5% (max)	6% (max)
5	Sulphuric Trioxide (SO3)	3% (max)	3% (max)	3% (max)
6	Total loss on Ignition %	4% (max)	4% (max)	4% (max)
B.	**Physical characteristics**			
1	Specific surface (Cm^2/g)	225 m^2/kg. (min)	225 m^2/kg. (min)	225 m^2/kg. (min)
2	Setting time (minutes)			
a	Initial setting time	Not less than 45 minutes	Not less than 30 minutes	Not less than 30 minutes
b	Final setting time	Not less than 600 minutes	Not less than 600 minutes	Not less than 600 minutes
3	Soundness			
a	By le-chataller (MM)	10mm (max.)	10mm (max.)	10mm (max.)
b	By Auto clave (%)	0.8% (max.)	0.8 %(max.)	0.8 %(max.)
4	Compressive Strength (N/mm2)			
a	072±1 hour; 3 days	16 Mpa (min.)	23 Mpa(min.)	27 Mpa (min.)
b	168 ± 1 hour: 7 days	22 Mpa (min.)	33 Mpa (min.)	37 Mpa (min.)
c	672±4 hours:28 days	33 Mpa (min.)	43 Mpa (min.)	53 Mpa (min.)

(NBC101:1994, 2064), (IS8112:1989, 2005), (IS12269:1987, 1988 as Cited in Mishra and Chaudhar,2018)

2.17.1. Control Charts

A control chart is a graphical tool for monitoring the activity of an ongoing process. Control charts are sometimes referred to as **Shewhart control charts,** because Walter A**.** Shewhart first proposed their general theory. The values of the quality characteristic are plotted along the vertical axis, and the horizontal axis represents the samples or subgroups (in order of time), from which the quality characteristic is found. Samples of a certain size (say 4 or % observations) are selected and the quality characteristic (say, average length) is calculated based on the number of observations in the sample. These characteristics are then plotted the order in which the samples were taken in (Mitra ,2001)

Several benefits can be realized by using control charts. Such charts indicate the following:

1. When to take corrective action. A control chart indicates when something may be wrong so that corrective action can be taken.
2. Type of remedial action necessary. The patterns of the plot on a control chart diagnoses possible causes and hence indicates possible remedial actions.
3. When to leave process alone. Variation is part of any process. A control chart shows when an exhibited variability is normal and inherent such that no corrective action is necessary. Inappropriate overcontrol through frequent adjustments only increases process variability.
4. Process capability. If the control chart shows a process to be in statistical control, we can estimate the capability of the process and hence its ability to meet customer requirements. This helps product and process design.

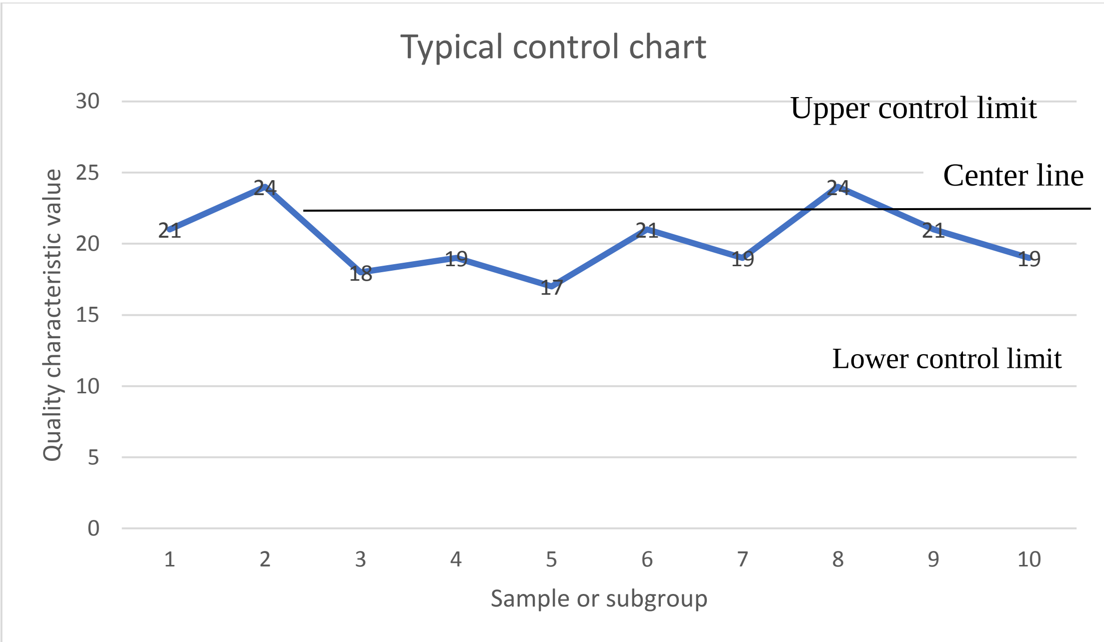


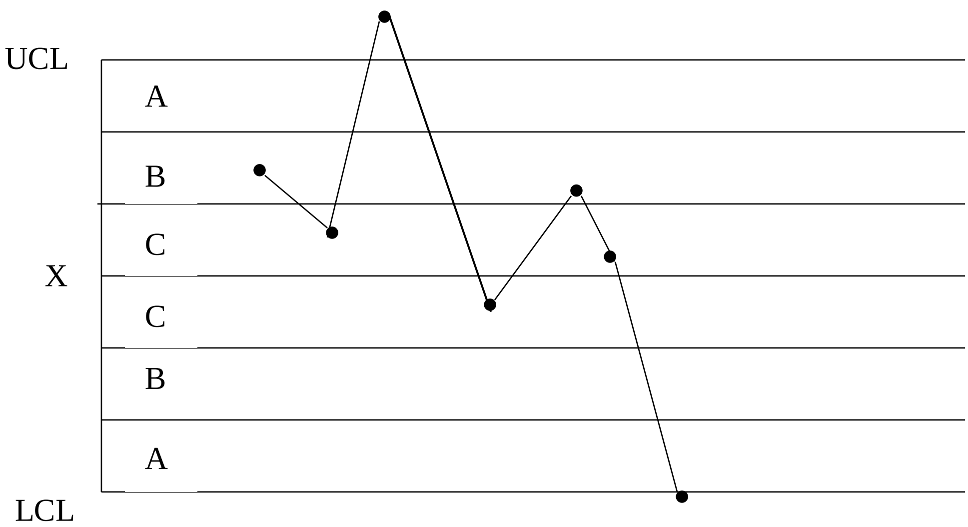
Figure 2.6 Quality Control Charts (Mitra, 2001)

5. Possible means of quality improvement. The control chart provides a baseline for instituting and measuring quality improvement. Control charts also provide useful information regarding actions to take for quality improvement.
(Mitra, 2001)

There are various tests that can be used in conjunction with a control chart to identify special-cause variation:

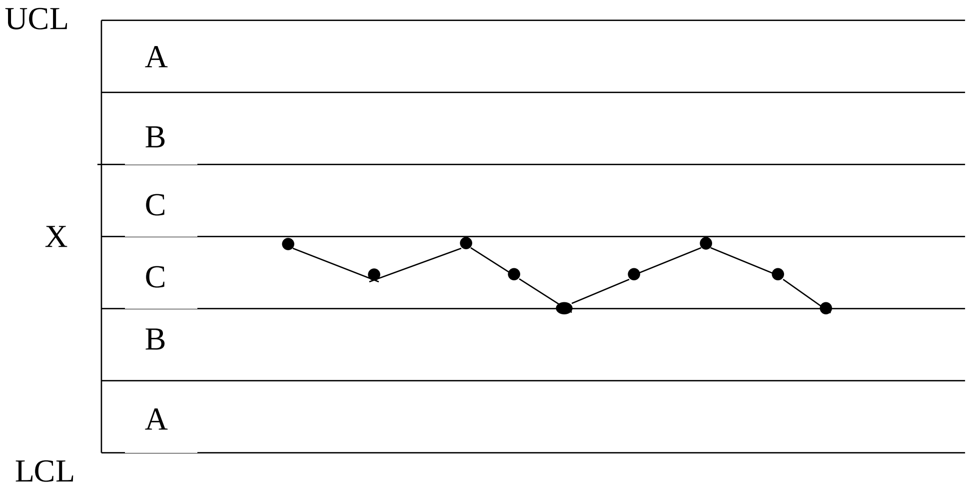
Test 1: One beyond Zone A

1 point is outside the control limits. Problem indicated -A large shift. In mean chart it indicates Wrong setting in measuring and plotting, incomplete operation, over-correction, tool breakage, gage jumped setting.



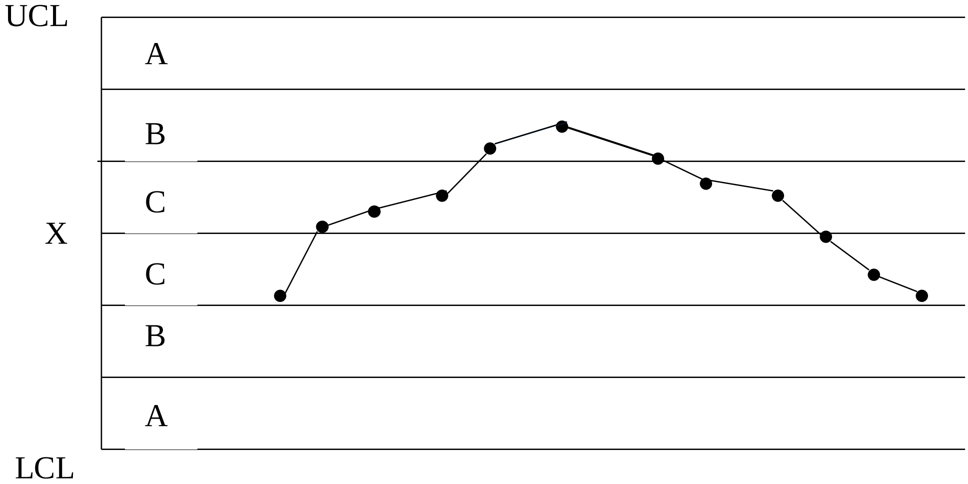
Test 2: Nine points in a row in Zone C or beyond

8/9 points on the same size of the center line. Problem indicated - A small sustained shift. In Mean Chart it indicates change in material, new tools, new machine, change in work procedure, change in operator, new operator change, failure to recalculate control limits when process has changed, fixture changed, changes in operators motivation.



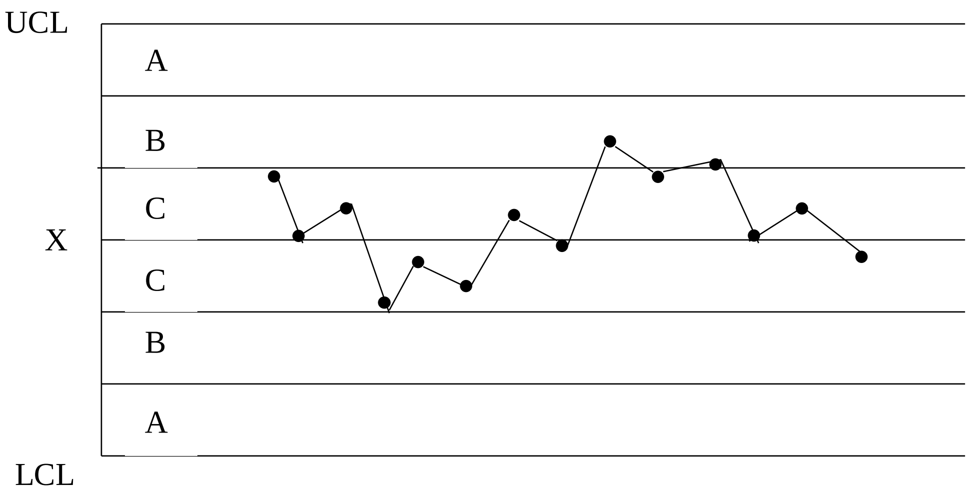
Test 3: Six points in a row steadily increasing or decreasing

6 consecutive points are steadily increasing or decreasing. Problem indicated - A trend or drift up or down. In X bar chart it also signifies change in material, new tools, new machine, change in work procedure, change in operator, new operator change, failure to recalculate control limits when process has changed, fixture changed, changes in operator's motivation. It also signifies wearing of tools or some machine parts, operator fatigue, seasonal factors, machine warmup and cool down, inadequate maintenance.



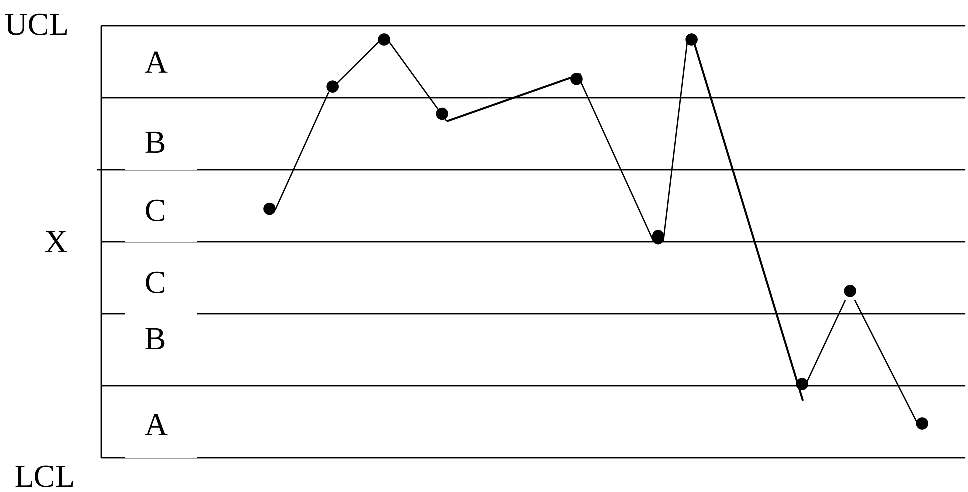
Test 4: Fourteen points in a row alternating up and down

14 consecutive points are alternating up and down. Problem indicated-Non-random systematic variation. In X bar chart it also signifies change in material, new tools, new machine, change in work procedure, change in operator, new operator change, failure to recalculate control limits when process has changed, fixture changed, changes in operator's motivation.



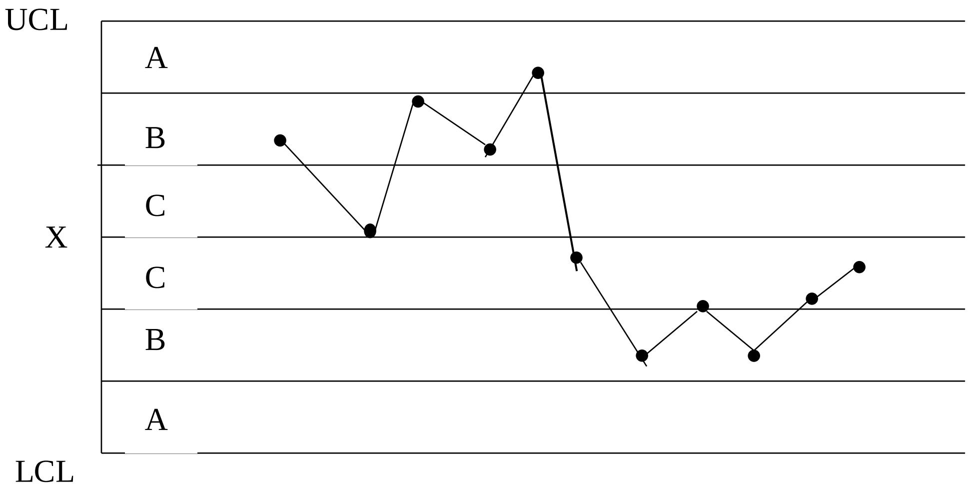
Test 5: Two out of three points in a row in Zone A or beyond

2 out of 3 consecutive points are more than 2 sigma from the center line in the same direction. Problem indicated-A medium shift. It also signifies wearing of tools or some machine parts, operator fatigue, seasonal factors, machine warmup and cool down, inadequate maintenance.



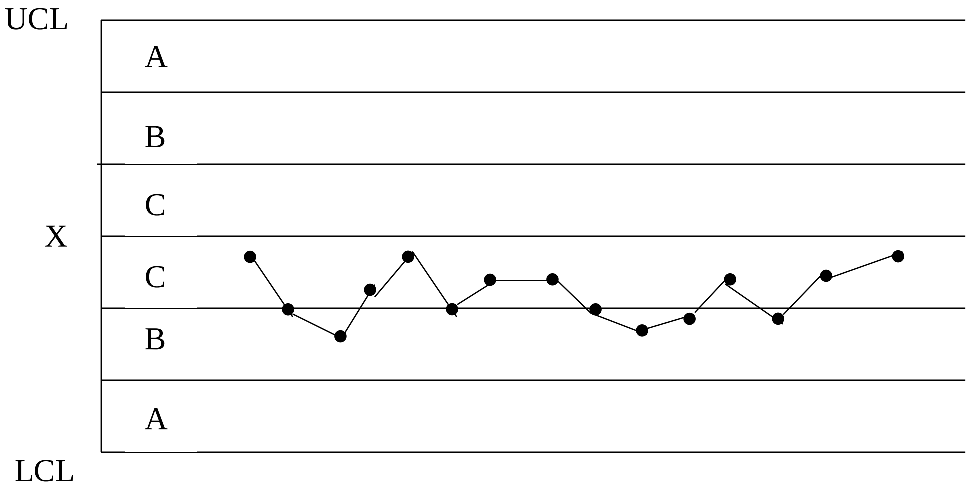
Test 6: Four out of five points in a row in Zone B or beyond

out of 5 consecutive points are more than 1 sigma from the center line in the same direction. Problem indicated - A small shift. In X bar chart it indicates due to incorrect data, non-recalculated control limits after process improvement, incorrectly calculated control limits



Test 7: Fifteen points in a row in Zone C (above and below centerline)

15 consecutive points are within 1 sigma of the center line. Problem indicated-Stratification It might be due to tampering, two systematically alternating causes are producing different results like two alternating suppliers.



Test 8: Eight points in a row on both sides of centerline with none in Zones C

8 consecutive points on either side of the center line with not within 1 sigma. Problem indicated- A mixture pattern. It indicates overcontrol and incorrect subgrouping.

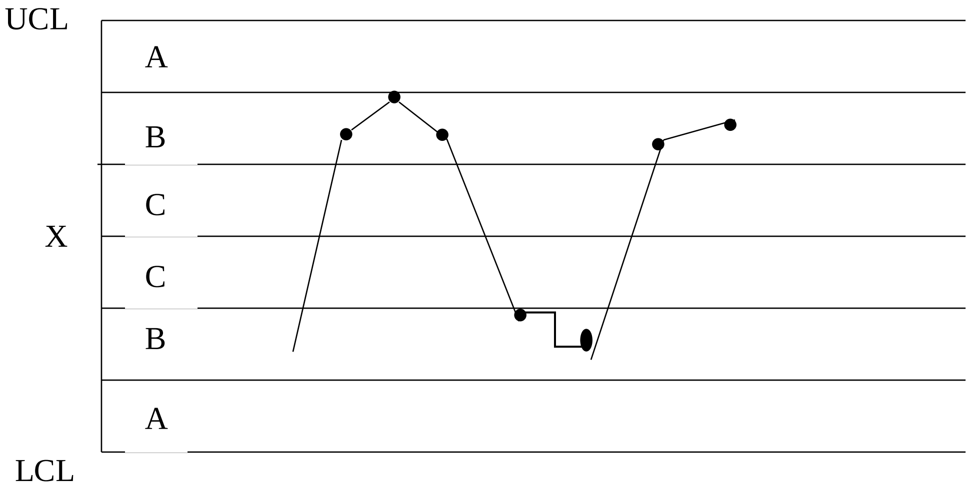


Figure 2.7 The Nelson rules for tests of special causes
(adopted from the research of Nelson)

2.17.2 Building of Control Charts

To create a control chart, central line (CL) as well as lower and upper control limits, LCL and UCL respectively are necessary. For the calculation of These two limits the knowledge of the "natural" standard deviation of the process is required. Its value is computed from the whole population after the subtraction of the outliers. This latter subpopulation consists of highly diverging points where the source of deviation is unknown or known but abnormal. In case the source of abnormality is known, quality department must act to eliminate this source (Tsamatsoulis, n.d.).

Control limits for the R – Chart:

The Central Limit (CL) = $\bar{R}$

The Upper Control Limit

(UCL) = $\bar{R}D4$

The Lower Control Limit

(LCL) = $\bar{R}D3$

D3 and D4 are obtained from Quality Control tables.

Control limits for the X bar Chart:

The Central Limit (CL) = $\bar{\bar{X}}$

The Upper Control Limit (UCL) = $\bar{\bar{X}} + 3\sigma/\sqrt{n}$

The Lower Control Limit (LCL) = $\bar{\bar{X}} - 3\sigma/\sqrt{n}$

$\sigma = \bar{R}/d2$

The values of d2 are obtained from statistical quality control tables.

METHODOLOGY

3.1. Study Area

The research is Ex-post facto research as a comparative case study based on Experiments.

The study area was Sarbottam cement factory located at Nawalparasi for production assessment, quality assessment and supply chain management. Whereas for the study of some part of credit policy, head office at Subidhanagar, Kathmandu was also approached.

3.2. Data Collection

Primary data are the main for this research work.

Lab test

Lab test were performed in the private lab of Sarbottam Cement and in the lab of Department of Road. In the lab of Department of Road, Compressive strength test were carried out while in private lab, other tests like consistency test, setting time test, Chemical test are carried out along with the compressive strength test.For the brand comparison AOPC ,M OPC, S OPC and Sarbottam OPC and Sarbottam PSC cement were selected randomly from the brands of cements available in Kathmandu Valley.

For comparison of compressive strength, Samples of around 5 kg were selected for each brand of cement and they were placed in air tight beaker with letter assigned to it in order to keep secrecy of brand and manipulation in the laboratory. The sample beakers were then sent to the lab for testing.

For the determination of variance of quality depicted via control charts systematic Random Sampling was done. The data of cement physical and chemical test were recorded for 180 days. To obtain sample of 30, interval size of 6 was selected by dividing 180 by 30. So, the first element of the sample was the result of 6th day, then with the further interval of 6, data for 12th day sample was selected and so on.

For the field test of cement Jorpati, Kathmandu area was selected by writing the name of each area and assigning number to them. Then randomly a number was picked.

In the continuous operation of 24 hr. Total 12 samples of 4 Kg were taken per day for physical and chemical test from the feed. Chemical test was performed in XRF machine while physical test like Setting time test, Fineness test, Strength test were done as per Indian Standard IS 4031 Part 3, Part 5 and Part 6. The result of the 12 samples were averaged to get the mean value for the day.

Compressive strength test

200 gm of Cement was mixed with the 600 gm of sand. Sand comprised mixture of three grades, Grade 1, grade 2, grade 3. 200 gm of each grade of sand were taken to make 600 gm of sand content. Water was added to sand and cement. After mixing cement sand and water cleaned and oiled (on interior face) Mould was placed on the vibrating machine and held it in position by clamps provided on the machine for the purpose. The Mould was filled required amount of mortar and vibrated for 2 minutes at a specified speed of 12000 per minute to achieve full compaction. The Mould was removed from the machine was kept it in a place with temperature of 27 ± 2^0C and relative humidity of 90% for 24 hours. To maintain the temperature air conditioning was used and humidifier was used to maintain the relative humidity. Cubes were removed from the Mould at the end of 24 hrs. and immediately submerged in fresh clean water. The cube was taken out of the water only at the time of testing. Total 9 cubes were prepared for each beaker of sample collected from feed. The cubes were tested in Compression Machine. The load was applied uniformly, starting from zero at a rate of 35 N/mm^2/minute.

Setting Time test

The consistency test was used to obtain the water required to give the paste normal consistency (P). 400 g of cement were taken and cement paste were prepared with 0.85P of water by weight of cement. Gauge time was kept between 3 to 5 minutes. the stop watch was started at the instant when the water was added to the cement. This time (a) was recorded. The VicatMould was filled completely with the cement paste and the surface of the paste was smoothed off completely making it level with the top of the Mould. The cement block thus prepared was called test block. The test block was placed in the Mould, under the rod bearing the needle. The needle was lowered gently until it came in contact with the surface of test block and quickly released, allowing it to penetrate into the test block. In the beginning the needle completely pierced the test block. This procedure was repeated till the needle fails to pierce the block for about 5 mm measured from the bottom of the Mould. This time (b) was noted.

For determining the final setting time, the needle of the Vicat's apparatus was replaced by the needle with an annular attachment. The cement is considered finally set when upon applying the final setting needle gently to the surface of the test block; the needle made an impression thereon, while the attachment failed to do so. This time (c) was recorded.

Calculation :

Initial setting time=b-a

Final setting time=c-a,

Where,

a=Time at which water is first added to cement

b=Time when needle fails to penetrate 5 mm to 7 mm from bottom of the Mould

c=Time when the needle makes an impression but the attachment fails to do so.

Chemical Analysis

The Chemical analysis to determine MgO and SO_3 content were carried out via XRF Machine. For this 200 Gm of clinker was collected from the feed and was grinded in the lab grinder. About 20 gm of ground clinker was mixed with boric acid in the ratio of 10 parts of clinker to 1 part of boric acid by weight. Then the sample was pressed by briquette press machine to form pellet. Then the pellet was transferred to XRF machine for analysis.

3.3. Analysis and interpretation of data

For the brand comparison in case of compressive strength test, 2 bags of samples of each brand were collected from the market of Kathmandu valley. 30 cubes of each brands were casted to determine 3 days, 7 days and 28 days strength of cement with 10 cubes for each day. For test cubes, 5 samples were taken from each bag.

Following were the data during the test of the cement:

Temperature inside Laboratory: 27+2

Size of Mould: 7.06 cm

Amount of water to prepare per cube:

Amount of cement to prepare per cube: 200 g

Amount of Sand:600 g

Source of Sand: ISI Tamil Sand

Source of water: Tap water with average PH range of 7.2

The results obtained after analysis were presented in graphical and descriptive form. Information obtained from lab test were analyzed and presented using different charts and tables.

3.7. Research Matrix

The research matrix is presented in table below

Objective	Information required	Data source	Methodology	Output
To analyze the variations in quality parameters of Sarbottam Cement	Strength Setting time Soundness Chemical content	Laboratory	Test and Experiment	Variations in quality parameters
To compare the strength of Sarbottam Cement with respect to other brands	Compressive strength results	Laboratory	Test and experiments	Quality analysis of cement and Quality Control chart

ANALYSIS

4.1 Quality Control Charts

The test result of 3 days strength is within control limits. There is no any presence of out of control process. 3 days strength of cement is the measure of the strength of the cement. According to NS 49 as mentioned in table in literature review the minimum 3 days strength for OPC should be 16 N/mm^2 and in the analysis of the collected result LCL is set 25 N/mm2 which is greater than the required standard as shown in Figure 4.1. All the samples are above LCL, hence all the collected samples show strength greater than the required strength by NS 49.

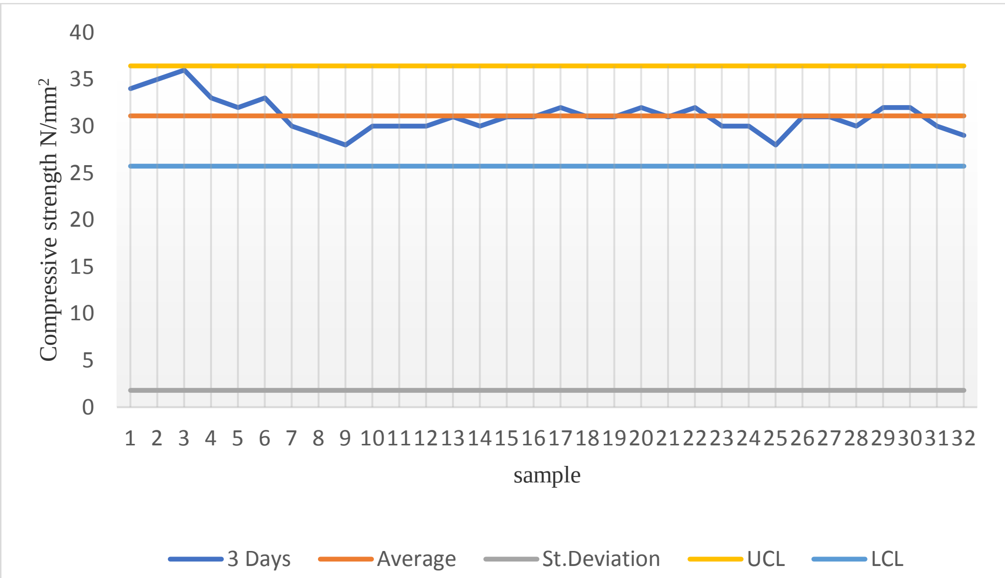


Figure 4.1 Mean Chart for 3 Days Strength

Control chart for 7 days is shown in figure 4.5. The test result of 7 days strength is within control limits. There is no any presence of out of control process. According to NS 49 as mentioned in table in literature review the minimum 7 days strength for OPC should be 22 N/mm^2 and in the analysis of the collected result LCL is set 35 N/mm2 which is greater than the required standard as shown in Figure 4.2. All the samples are above LCL, hence all the collected samples show strength greater than the required strength by NS 49.

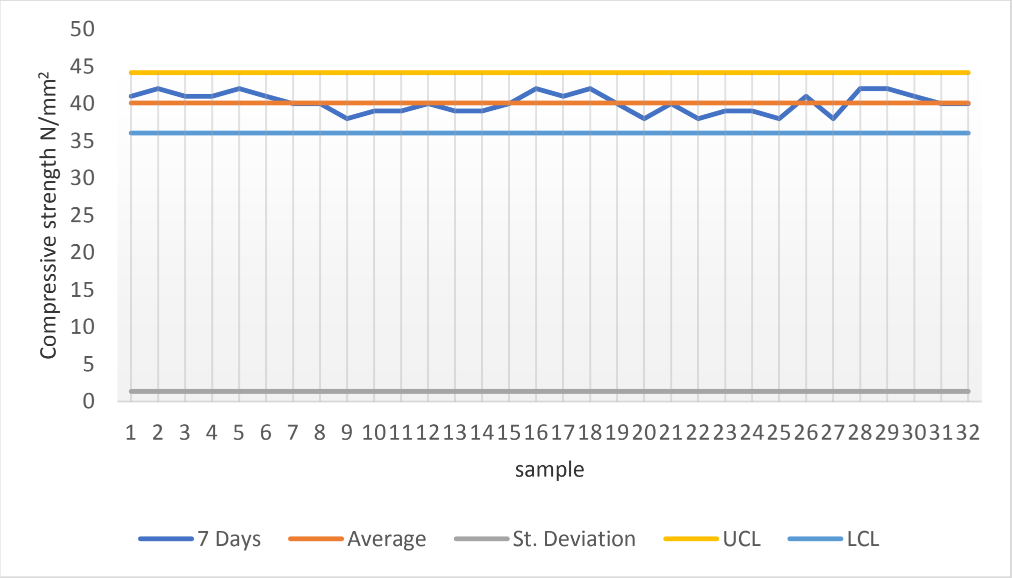


Figure 4.2 Mean Chart for 7 Days Strength

The control chart for 28 days strength shows trend pattern as six points are continuously decreasing from sample 6 to sample 11. According to NS 49 as mentioned in table in literature review the minimum 28 days strength for OPC should be 33 N/mm^2 and in the analysis of the collected result LCL is set 38 N/mm2 which is greater than the required standard as shown in Figure 4.3. All the samples are above LCL, hence all the collected samples show strength greater than the required strength by NS 49.

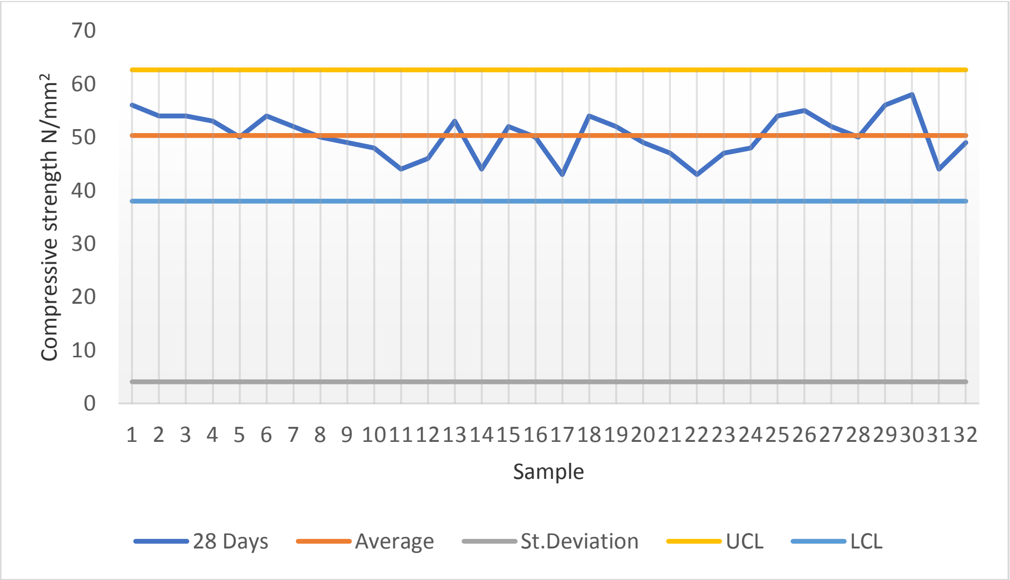


Figure 4.3 Mean Chart for 28 Days Strength

The test result of MgO content is within control limits. There is no any presence of out of control process. Higher MgO content cause expansion of the cement in the long run and make it unsound. Since the MgO content are within the limit which is restricted to 5 % by the standards during the production, hence the cement is sound. Figure 4.4 shows the variation of MgO with respect to the collected sample. As per the literature review on the effect of MgO, unsound cement cause cracking of the cement in the long run.

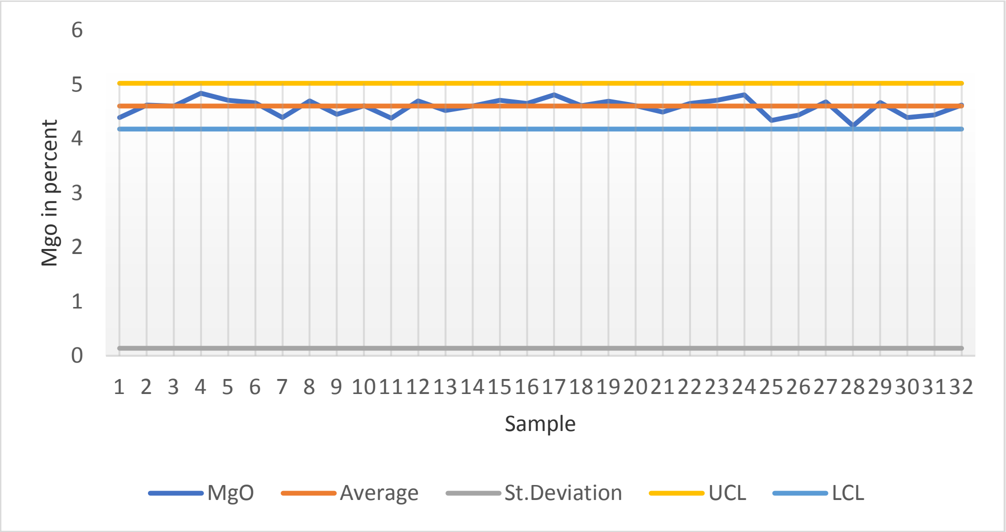


Figure 4.4 Mean Chart for MgO Content

The test result of SO3 content is within control limits. There is no any presence of out of control process. The effect of Sulphur trioxide in cement within the prescribed limit makes it sound. If the Sulphur is present more than the prescribed limit chance of Sulphur attack increases which cause undue expansion of cement.

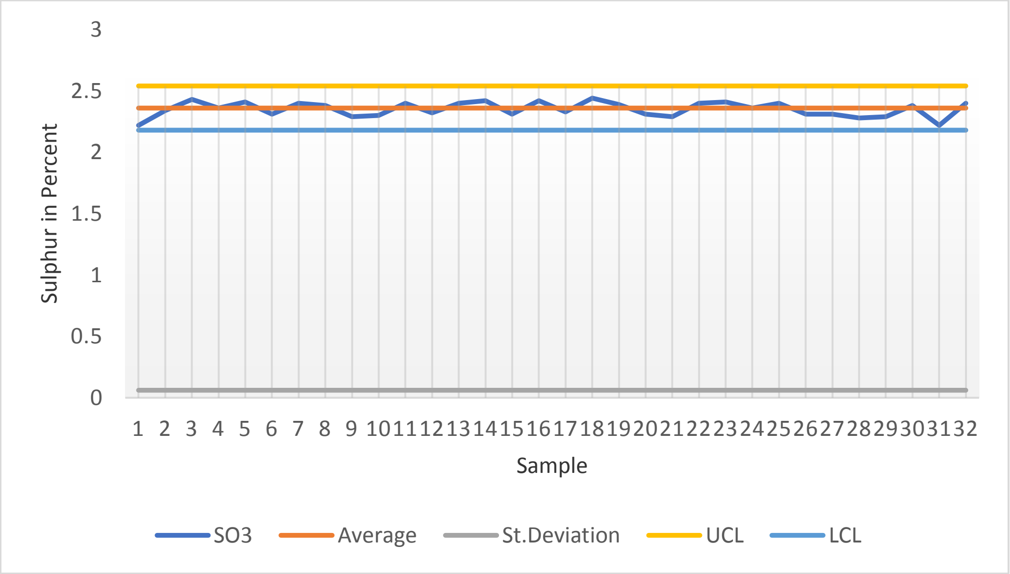


Figure 4.5 Mean Chart for SO_3 Content

In this control chart one point is beyond control limit which indicates problem of large shift. This might suggest special cause of variation. This signifies outlier.The reason for outlier was investigated.

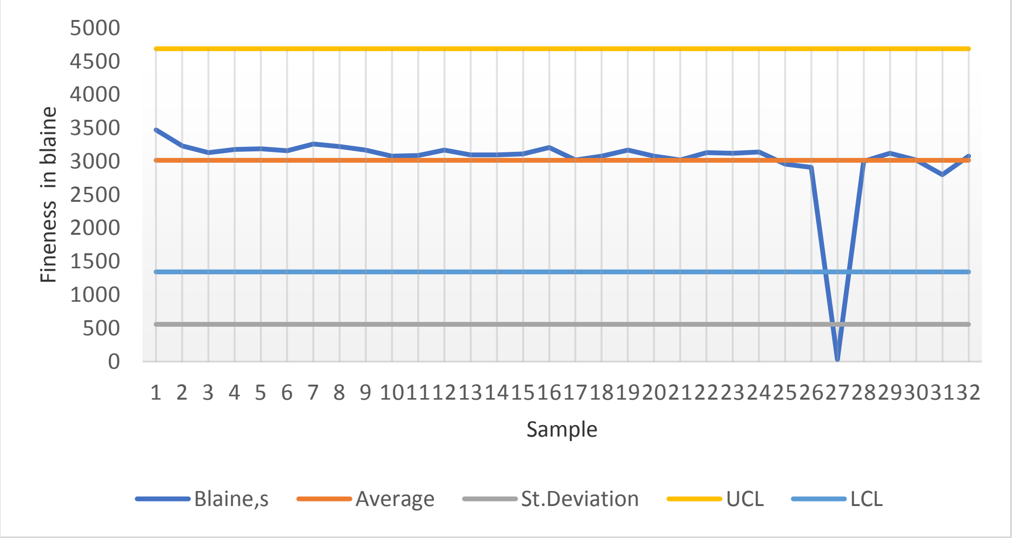


Figure 4.6 Mean Chart for Fineness

It was suspected that the main reason of the outlier was due to technical issues regarding VRM. The effect of this outlier should have impacted on the initial strength of the cement. As per literature review on fineness of cement, following effect should have occurred. Hydration rate should have affected, and in turn, the strength would have decreased. Decreasing fineness might have caused decreased rate of hydration, low strength, and low heat generation. But upon studying the strength of 3 days,7 days and 28 days not any variation in strength was found. So, error in recording data was considered as the most probable cause.

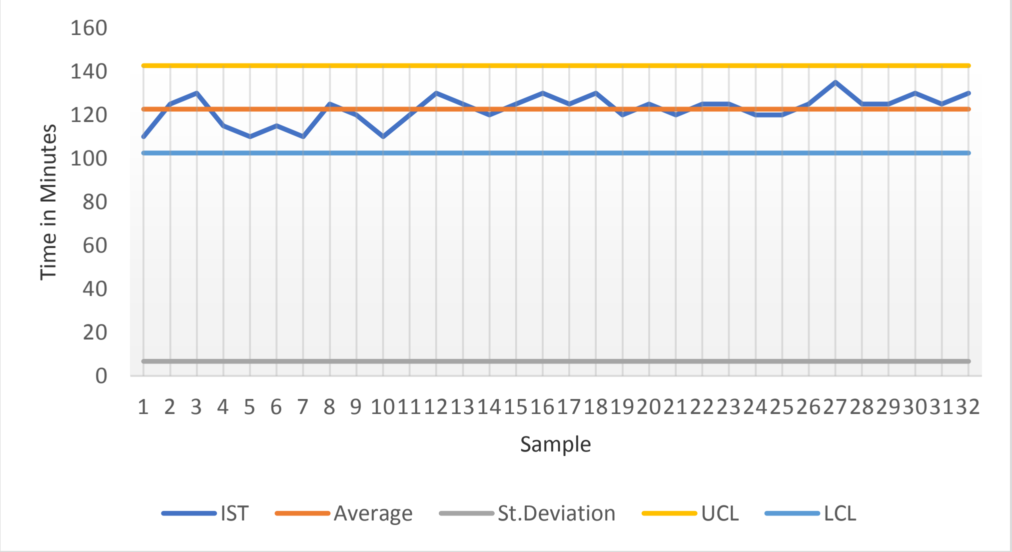


Figure 4.7 Mean Chart for Initial Setting Time

Control Charts for Initial Setting Time (IST) is shown in figure 4.7. The test result of IST is within control limits. There is no any presence of out of control process. Higher IST is preferable than lower IST because it helps in concreting as it gives enough time to concrete to be mixed and placed. Since the IST are within control limit, SC gives sufficient time for placing after mixing.

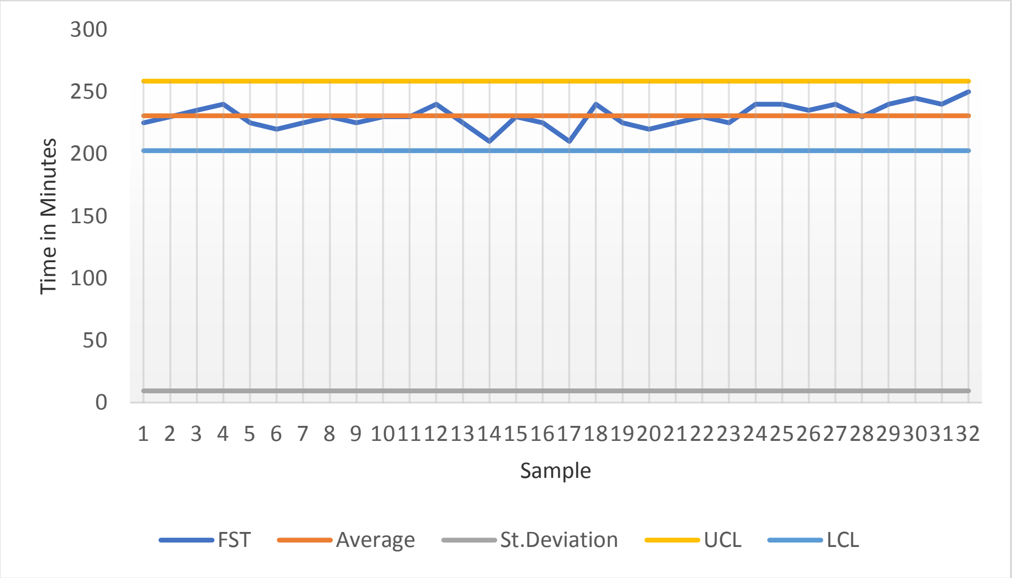


Figure 4.8 Mean Chart for FST

The test result of FST is within control limits. There is no any presence of out of control process. FST should be short as possible as it indicates the hardening and strength attaining of cement. The FST are within prescribed limit of SC.

4.2 Field test observation of cement:

Total of 30 samples were selected out of 42 construction sites in Jorpati Area.

Of the three bags where date of manufacturing was not present, two bags had warm temperature inside bag and one bag had lump. One bag had warm temperature despite having date of manufacturing printed. Two bags having smell of earth didn't have warm temperature or lump. It also had date of Manufacturing. The result of the field test is summarized in table 4.1.

Table 4.1: Summary of the result of the field test

Field test		**Number**
Date of Manufacturing	Present	24
	Not Present	6
Cement color	Grey	30
	Other	0
Presence of Lump	Yes	1
	No Lump	29
Water Sinking Test	Float and sink	30
	Floats	0
Glass Plate test	Sets without crack	30
	Cracks	0

4.3 Brand Comparison

4.3.1 Strength Comparison

The average value of strength of 10 cubes of the cement brands are:

Cement brand	**3 days strength**		**7 days strength**		**28 days strength**	
	Private Lab	DOR Lab	Private Lab	DOR Lab	Private Lab	DOR Lab
A	31.5	34.33	41.5	44.33	51.9	54.33
M	31.2	36.67	42.4	46.67	54	55.33
Sarbottam	35.1	39.67	45.4	50.33	57.2	60.67
S	30.1	26.67	37.1	34.67	51.2	47.33

The strength of Sarbottam Cement was found higher in the test carried out in the Private Lab. Strength of S cement was found lowest . Although all the brands showed significantly higher value of strength then mentioned in NS 49.

4.3.2 Ex-Factory Rate Comparison of Cement

Cement	**Ex-Factory Rate (NRs per 50 Kg Bag of cement) on 14 February 2017**
A	850
M	830
S	870
Sarbottam	860

5.1 CONCLUSIONS AND RECOMMENDATIONS

For quality consideration the variation in parameters like strength, setting times, MgO and So3 are within the limits over period of six-month study from which it can be concluded that standard quality of the cement produced by Sarbottam Cement.Though field test of cement showed some defects like lump formation and absence of manufacturing date, the production of cement can be considered consistent within the time frame of 6 months.

About the strength of Sarbottam cement it can be concluded that it is higher compared to other cement like S, A, M when tested under the similar condition. The strength corresponds to 53 grades of cement as given by Indian Standard. Although all the compared cements satisfy the Nepal Standard, from the conducted experiment it shows that except S all other brands correspond to 53 grade cements

5.2 Limitation of Research

Study was limited within Sarbottam Cement Factory and Head Office. Result of Lab was based on the reports obtained and test carried out in the internal lab of Sarbottam Cement. To determine the variations in quality only few parameters like strength, setting times and magnesia and Sulphur content were considered. For the analysis of the data 6-month period was selected. Results are based on this data. Most of the data were collected from internal staffs and internal records. For the Field test certain section Jorpati was chosen. For Brand comparison3 brands were selected and represented with codes viz; A,Sand M for ethical issue. A, S and M were selected randomly from the list of brands of cement available in the Kathmandu valley.

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