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ADDIS ABABA INSTITUTE OF TECHNOLOGY

CENTER FOR ETHIO-MINES DEVELOPMENT

Master of Engineering in Mineral Processing

"EFFECT OF PARTICLE SIZE ON COAL CLEANING BY FROTH FLOTATION METHOD IN DIDAYE WOREDA, WOLAITA ZONE"

By

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A project submitted to the centre for Ethio-mines development, Addis Ababa University Institute of Technology in the partial fulfilment of the requirements for the Degree of Master of Engineering in Mineral Processing.

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Declaration

I hereby certify that the work contained in this project paper titled "EFFECT OF PARTICIARY SIZE ON COMBINATE CLEANING COAL BY FROTHER FLOTATION METHODES IN DIDAY E WORDA ZONE" is my original work; that it has not been submitted for a degree at any other university; and that all sources used for the thesis are duly acknowledged.

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APPROVAL SHEET

This Project paper entitled "EFFECT OF PARTICLE SIZE ON COAL CLEANING BY FROTH FLOTATION METHOD IN DIDAYE WOREDA, WOLAITA ZONE' 'prepared and submitted by Tiruye Kassaw in partial fulfilment of the requirements for the subject project work for Master of Engineering in the University of Addis Ababa; Centre for Ethio-mines development in department of mineral engineering has been examined and is hereby recommended for acceptance and approval for final oral defence.

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Abstract

The aim of this study is to investigate the effect of particle size on the efficiency of coal cleaning process by froth flotation. Coal cleaning is an important process, which involves removing ash, and other impurities from coal to improve its quality for energy and industrial use. Froth flotation is a widely used method for coal cleaning, which relies on the difference in surface properties between the coal particles and the mineral matter. However, the efficiency of froth flotation is greatly affected by the size of coal particles. In this study, four different sizes range of coal particles (-500µm+350πm, -350µm+225µm, -225µm+180µm and-180mµ+100µm) were tested for their ability to float in the froth flotation process. Results showed that the efficiency of coal cleaning was highest for particles ranging from at this particle size -350µm+225µm, while particles above +350µm showed the poorest performance. The results suggest that particle size is a critical factor in the success of coal cleaning by froth flotation, and -350µm+225µm coal particles are more amenable to this process. The findings of this study will help in optimizing the coal cleaning process to improve its efficiency index, combustible recovery and ash rejection.

Keywords: Coal, particle size, Coal cleaning, Froth flotation, Ash rejection, Combustible Recovery, Efficiency index and concentrate.

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Abbreviations

WCA………………………………………………...........................World Coal Association

ROM………………………………………………..Run-of-mine

Ac ………………………………………………………………...Ash content of clean coal

Af.…………………………………………………………………..….Ash content of feed

WC………………………………………………………………….Mass of clean coal

Wf..Mass of feed

Wt...Weight of coal in the tailings

WC, daf... Mass of dry-ash free clean coal

Wf, daf..Mass of dry-ash free feed

EI...Efficiency of index

CR..combustible recover

CHAPTER ONE

INTRODUCTION

1.1. Background

Coal accounts for around 30% of primary energy worldwide, 41% of global electricity production, and is the world's most plentiful fossil fuel (WEN, 2017). Coal will continue to be the primary source of energy until 2050 despite environmental concerns because of its abundance, ease of recovery, and low cost (BP, 2017). The world's known coal reserves total more than 1140 billion tons, which, at current consumption rates, would be enough to meet the world's energy needs for more than 153 years (BP, 2017). The World Coal Association (WCA) reports far lower coal reserves of roughly 860 billion tons, or 112 years' worth of coal production (WCA, 2012).

A variety of technologies must be employed to achieve the critical Item quality in particle size, ash, sulfur and moisture content. Combination coal arrangement technologies need to be employed in order to produce coal with the highest financial esteem. In order to produce high-quality coal with the highest monetary esteem, several coal preparation technologies act in concern. What coal planning innovations work in concern depends on the physical and chemical characteristics of ROM coal for coarse coal, gravity division innovations are usually used. For fine coal, it is common to use coal buoyancy (commonly under 0.5mm in measure) but effective coal cleaning of coarse particles (-1mm) has been described in detail (Brozek, 2013; Laskowski, 2010). The most extreme particle size that bolster coal can be considered extremely floatable is approximately 28 mesh size (0.59mm).

Within the past, a common approach to treating coal fines (slimes) was to dispose of and coordinate them to the deny lakes. Concurring to a consider conducted by the USA's National Investigate Board, over 70 to 90million tons of coal fines were deposited in denies lakes within the USA every year (NRC, 2002). Foam buoyancy is considered to be one of the uncommon commercially accessible innovations for cleaning and recouping of coal fines (Yoon and Aksoy, 1999).

The physical and chemical properties of the treated material, coal and mineral matter, are highly variable. Coal flotation is the most effective method for the separation of coal particles in a narrow range of particle size, usually between 50 μm and 600 μm. There are several models used to describe the process of coal flotation. The most widely used is the flotation kinetics model.

This model relates various process parameters, such as particle size, slurry size, and hydrodrastic properties, to the constant flotation rate. The particle size is considered one of the key parameters of coal flotation because it has a significant impact on the flotation rate.

Coal flotation principle is based on the surface properties of hydrophobic coal compared to hydrophilic mineral matter (see Laskowski, 2001). Coal floatation is a highly complex three-step process involving coal particulates, oil droplets and air bubbles whose behavior is restricted by several sub-processes due to their interaction (Polat, 2003). There are several factors that influence the process such as coal properties, chemistry and machine (wills, 2006; lnget al., 2015; peng et al., 2015).

The part of coal which consists of Shale, Clay, Sandstone, Silica, Pyrite, Gypsum, Sulphates and Phosphates constitute the mineral impurity in coal. There are two types of impurities such as Inherent of Fixed and Extraneous or Free impurities. Inherent of fixed impurities gets associated to coal during its formation period and extraneous or free impurities get associated during the mining activities, storage and transportation, after the coal is formed

1.2. Statement of the problem

Of all the wet coal cleaning methods, thick media separation or jigging is the most common in commercial use. Although the froth float method is not widely used across the country, it does open up a valuable area for experimentation and study. The two wet coal cleaning methods mentioned above cannot clean-up fine coal to below 1 mm. In this project, we are looking at how particle size affects coal cleaning using foam floatation to address the issues mentioned above.

1.3. Scope

The project aims to investigate the effect of particle size on coal cleaning by froth flotation. The scope of the project includes:

- Conducting a literature review on the theory and principles of froth flotation and the effect of particle size on coal cleaning.
- Designing and conducting experiments to determine the effect of particle size on coal cleaning using froth flotation.
- Anal zing the experimental data to determine the optimal particle size for coal cleaning by froth flotation.
- Comparing the results of the experiments with the literature review to draw conclusions and make recommendations for future research.

- Writing a comprehensive report that outlines the methodology, results, conclusions, and recommendations of the project.

The scope of the project is limited to the investigation of the effect of particle size on coal cleaning by froth flotation. Other factors that may affect coal cleaning, such as coal type, frother dosage, and collector dosage, will not be considered in this project.

1.4 Objective of the study

1.4.1 General objective

The general objective of this study is to investigate how particle size affects the efficiency of coal cleaning through froth flotation. By examining the relationship between coal particle size and the effectiveness of the flotation process, the study aims to provide insights into the optimal conditions for coal cleaning and suggest improvements to current practices.

1.4.2. Specific objective

To achieve the stated general objective above the following objective will be intended to be conducted:

- To determine particle size of coal
- To evaluate effect of particle size on coal floatation
- To determine the optimal particle size range for froth flotation of coal.
- To evaluate the relationship between particle size of coal and theash rejection, combustible recovery and efficiency index in coal flotation.

1.5. Significance of the project

The significance of this study on the effect of particle size on coal cleaning by froth flotation is multi-fold. Firstly, froth flotation is widely used as a separation technique in the coal industry to remove impurities from raw coal, and particle size is known to be a critical factor influencing the efficiency of this process. Investigating the effect of particle size on flotation could help optimize the coal washing process, leading to more efficient, cost-effective and environmentally friendly coal production. Secondly, coal remains one of the world's most widely used energy sources, and numerous countries rely heavily on coal production to meet their energy demands. By investigating the effect of particle size on coal cleaning, this study could contribute to the development of more sustainable and clean coal production methods, which could have important economic, environmental, and social impacts. Finally, the findings of this study could provide valuable insights into the fundamental principles governing the flotation of coal, which has important implications for research fields such as mining, mineral processing, and environmental science.

1.6 Arrangement of the project

This project is outlined in five chapters. Chapter one presents the framework of the study, starting with the introduction, statement of the problem, and objectives of the projects. Chapter two describes the review of related literature and techniques for recharge estimation. Chapter three outlines research methodologies as well as brief descriptions of all methods. Chapter four outlines the project effects of size on coal cleaning through froth floatation data analysis and discussions. Finally, Chapter Five provides the conclusion of the study and also makes recommendations for further studies

CHAPTER TWO

LITERATURE REVIEW

2.1 Literature Review of Coal

The wide term "coal" alludes to a set of strong fossil powers that are dark or brown in colour, basically composed of changed plant fabric, and regularly show up as creases inside other solidified strata. In a ideal setting, plant fabric breaks down naturally to produce coal. Taken after by coal's physical and chemical change within the beginning stages of codification, biochemical components are vital [D.W. Van Krevelen, 1961]. The degree and rate of calcification are both quickened by tall temperatures. Coalification regularly includes the ceaseless change of plant matter into coal, with each stage being recognized by a particular rank degree of calcification degree. With the taking after categories, the rank ordinarily rises: peats, brown coals, lignite, biturninous coals, and anthracites.

2.1.2 Diversity Of coal

The precise chemical and physical nature of coal has remained ineffectively characterized; since the term "coal" alludes to such a wide gather of materials. The variety in both the chemical and physical properties among and indeed inside each bunch is colossal. Coalification degree for the most part of increments with expanding profundity, so that inside the same store (and in some cases indeed inside the same crease) huge varieties in properties can happen. Consequently, care must be taken when deciphering the comes about of a coal ponder; the comes about and conclusions important to one cod may not apply to another [J.W. Leonard, ed., 1979]

2.1.3 Rank Classification

Various classification frameworks have been created to bunch coals into ranks. Of these, the American Society for Testing and Materials (ASTM) framework has picked up the more acknowledgments and is overskirts only utilized in North Armorica. Classification is reasonable for down to earth as well as logical purposes, in spite of the fact that rank isn't as vital a figure in coal planning because it is in coal utilization [J.W. Leonard, ed., 1979]. Be that as it may, the properties utilized to characterize rank may themselves be valuable in comparing the cleaning reaction of diverse coal materials. In al1countries the classification frameworks are basically based on the substance of unstable matter (I-e., that matter which distils as coal is warmed to around 950º[J.W. Leonard, ed.,1979]).Rank increments with diminishing unstable matter content (on a dry mineral-matter-free premise) within the taking after arrange: medium unstable bituminous or coking coal (22-3 1 %), moo unstable bituminous (14-22%), semi anthracite (8-14%), and anthracite (43%). On the other hand, fixe carbon (dry mineral-matter-free premise) is utilized as the essential classification parameter. Classification based on unstable matter (or settled carbon) alone is troublesome over 30% unstable matter.

2.2 Coal properties

The critical properties of crude coal perhaps categorized as physical properties, chemical properties, and surface chemical properties. Physical properties incorporate cruel molecule estimate; molecule shape; particular gravity; breakage characteristics (hardness, quality, versatility, friability, pound capacity); porosity; surface region; harmony dampness; surface dampness; electrical properties; and Maceral and mineral matter mineralogy and morphology. Chemical properties incorporate those decided from proximate and extreme investigations; characteristic dampness; chemical structure and utilitarian bunches; oxidizing capacity; unconstrained combustion potential; sums and sorts of follow components; agglomerative properties; ease of disintegration and uncommon properties for extraordinary employments (e-g., smoothness). Surface chemical properties incorporate hydrophobicity; sums and sorts of surface utilitarian bunches; sums and sorts of follow components; adsorption of ions; and zeta potential and point of zero charge (PZC)in solution[R.R. Klimpel, P.T. Luckie, eds., 1988.].

2.2.1 Size Composition

Measure composition of coal could be a relative sign of the ease of corruption of a coal, in turn, a work of friability and physical quality. Estimate is more often than not decided by sifter examination and may be communicated as a rate between two sifter sizes or by total rates. The measure and composition of run-of-mine coal is subordinate on a few components, such as physical quality, the nature of the break framework that characterizes the coal bed. And those variables imposed by the strategy of mining. Although there's a wide variation within the relative sums of coarse and fine sizes totally different coals, most coals show up to comply to a unequivocal design [J.W.Leonard, ed., 1979].Rosin and Rammler[P. Rosin and E.Rammler, 1933]developed a estimate conveyance that was found to apply to the yield of a mine.

2.3 Froth Floatation:

Froth flotation can be coined as a exceedingly versatile strategy for the physical division of particles based on the differences within the capacity of air bubbles to specifically follow to the specific mineral surfaces within the mineral or coal slurries. When connected to air bubbles, the particles are carried to the surface and expelled steadily, while the particles which are totally wetted remain within the fluid stage. Froth flotation can be executed for a wide run of mineral partitions because it employments chemical treatment strategies to specifically adjust mineral surfaces so that they have the fundamental properties for the division. As of now, it is being utilized as a flexible strategy of isolating sulphide minerals from silica gangue (and from the other sulphide minerals); isolating potassium chloride from sodium chloride; isolating coal, isolating coal from ash-forming minerals; expelling silicate minerals from iron ores; isolating phosphate minerals from silicates; and indeed non-mineral applications such as de-inking reused newsprint. Whether it is fine-grained minerals or coals that are not reasonable for gravity concentration, it is especially valuable [Kawatra S. Komar; crucial buoyancy].

The advantages are:

- It is suitable for fine coal (< 1 mm) e.g. mine dust, slack coal, washing rejects, slurries etc.
- It is especially used for producing ultra-pure coal for carbon ejectors.

The drawback can be its tall capital and running costs. Besides, it cannot clean uneven coals unless smashed to powder frame. Forward buoyancy operation may be a exceedingly complicated wonder as there are three stages included in this, i.e. strong coal or mineral, water as slurry medium and discuss bubbles, which in turn makes it a challenging area of consider. In spite of being presented within the 1900s and after various a long time of inquire about and development, this strategy of cleaning remains moderately less productive and isn't completely caught on. In spite of the fact that broadly utilized for the cleaning of mineral metals, it is still not effectively utilized for coal cleaning purposes.

CHAPTER THREE

MATERIALS AND METHODOLOGY

3.1. Materials

3.1.1. Apparatus and Instruments

The apparatus and instruments used in this study were; Universal Hot Oven, Jaw crusher (RoHs53743, Germany) , Centrifugal mill (RETCH 56402, Germany), Sieve Shaker (RETCH A200, Germany), Wedag flotation cell (Groppel 98, west Germany) and Sieve size at Addis Ababa Institute of Technology.

Figure1: Instruments those were used in the study

3.1.2. Chemicals and Reagents

The chemical reagents that were used for the research; kerosene (Industrial grade), N-Octanol.Coal ore sample was collected from an active mine Kindo Didaye woreda, in Bosa-Menera Keble specifically Kindo Mandeni area, which is found in South nation nationalities and people's regional state, Wolaita zone. The dried sample was crushed using a jaw crusher and grinded by a bitter cross mill. A working sample size obtained using a random sampling method followed by flatting the cone-shaped heap of coal sampling method was pulverised using a pulveriser and sieved through -500μm+350μm,-350μm+225μm,-225μm+180μm and -180+100 The samples were dried at room temperature, crushed, and sieved to obtain the desired particle sizes.

3.2 METHDOLOGY

3.2.1 Description of study area

The study was conducted at Kindo Didaye woreda, specifically in Bosa-Menera area, which is found in South nation nationalities and people's regional state, Wolaita zone. The distance between Addis Ababa to Wolaita Sodo is 328 Km by road. You can also find the distance from Addis Ababa to Wolaita Sodo using other travel options like bus, subway, tram, train and rail. Apart from the trip distance, refer Directions from Addis Ababa to Wolaita Sodo for road driving directions! Coal of the study area is a unique readily combustible, brown, brownish black, black dull or shining sedimentary rock composed mostly of carbon and hydrocarbons. The area surface topography varies from plains, gentle undulations to hills and valleys. The study area is covered with verities of litho logical units. Both sedimentary and igneous rocks are found in the study area. The most dominant litho logical units in the study area are Rhyolite, Basalt and Coal (Mr. Muse Paulo's project work p-20).

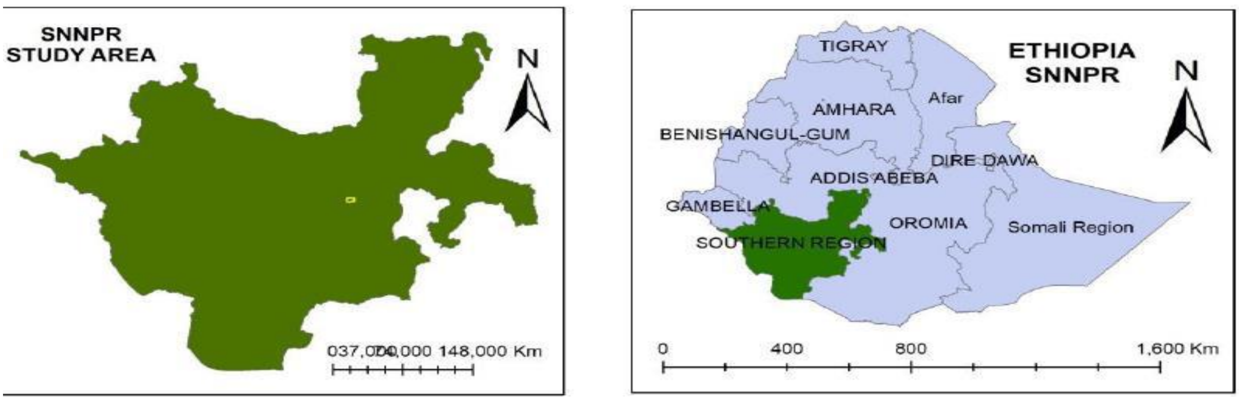

Figure 2: Location map

3.2.2 Sampling techniques

During sampling, the conditions such as recording the location and the thickness of the seams were taken into consideration. The representative samples from the study area were collected in plastic bags with an amount of 5 kg. Finally, the sample was transported from Kindo Didaye to Addis Ababa University Institute of Technology for processes.

The GPS location of the sample:p1;x (Easting) 319195,y (Northing) 743891 p2; x (Easting) 319261, y (Northing) 744170 p3;x (319443),y (744199), p4;x (319462),y (744000).The coal seams have a thickness that varies between 1 and 2m separated by clay partings.

3.2.3 Crushing and size reduction

To reduce the size of the collecting coal sample first sized by jaw crusher and then crushed by using cross bitter Miller and finally to prepare sieve analysis.

Figure 3: Crushing and size reduction

3.2.4 Experimental design

Laboratory froth flotation test work was conducted using a five litter Denver Agitair Laboratory Flotation Machine. Impeller speed was set at 1500 rpm throughout this project. Reagents were acquired by collecting SNNPR Regional state in wolleta zone from Didaye woreda samples of the coal flotation process reagents. Reagent addition was controlled by micro dispenser syringe of 0.1 litter capacity. Kerosene was used as the collector and N-Octanol used as Frothers. Throughout this project, reagent dosages are quoted in litters of kerosene per ton of feed. However, the collector to Frothers ratio was kept constant at a 1: 1 ratio of kerosene to carbonyl. In addition, water was used throughout the test work. PH was not controlled as it was constant at close to neutral pH.

For each test, the required dry weight of sample was added to the three liter cell and water was added to approximately one inch below the ce11 lip. The pulp was agitated for five minutes to allow al1 particles the opportunity to become completely wetted. The required amounts of kerosene and N-Octanol were then added and the pulp was conditioned for five additional minutes. Air was added (at the appropriate flow rate) and the froth manually removed with a plastic paddle for ten minutes or until the froth became barren.

Each of the concentrate and tailings products were filtered, dried, weighed, pulverized, and ashed in duplicate.-180µm+100µm,-225µm+350µm,-350µm+500µm and-500µm+350µm sieve sizes. And in addition aluminum paper was used for drying and dewatering of floating coal for this experiment.

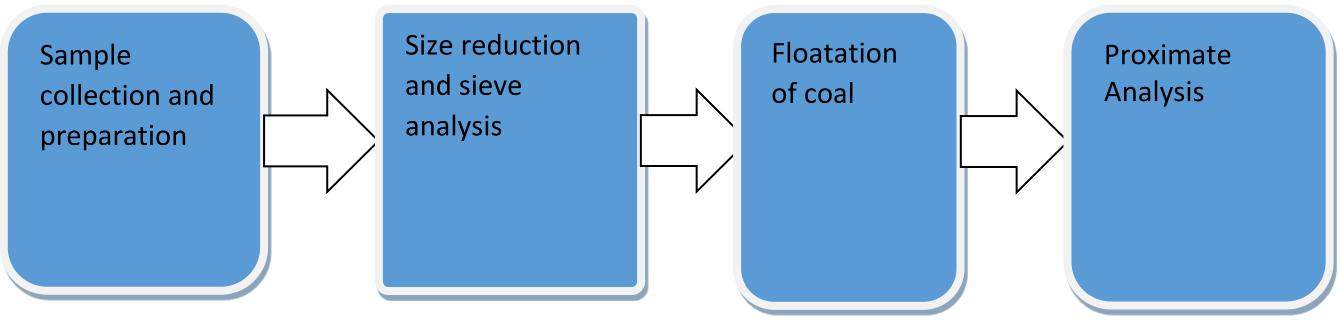

Figure 4: Experimental design

CHAPTER FOURE

RESULTS AND DISCUSSION

4.1 Floatation Result

As shown in table 1 the variables that are used during the flotation process are particle size, flow rate ((95g), dosages of reagents (Kerosene (0.1liter) and n-octanol (0.1liter)) and impeller speed. The preliminary of these working parameters in this study was done focused only the particle size of coal at constant at flow rate=95g, dosages of reagents (Kerosene=0.1 litter and n-octanol=0.1 litter) and impeller speed =1500rpm).

Table 1: Data of Clean Coal and Tailing

No	Particle Size range (µm)	Weight of feed (g)	%Moisture content	Weight of clean coal (g)	%Ash of feed	Weight of tiling coal (g	% Ash in clean Coal
1	-180+100	95	*5*	*42.4*	*31*	*52.6*	15
2	-225+180	95	*5*	*44.43*	31	50.6	14
3	-350+225	95	*5*	*45.22*	31	49.9	13
4	-500+350	95	7	41	31	53.9	14

4.1.1 Mathematical calculations

From the above data of clean coal all the cleaned coal was carried out in terms the „% Combustible Recovery (CR)„ Efficiency index and „% Ash Rejection (AR) ‟calculations. The mathematical formulae are given below. For this the weight of recovered coal and its ash content was also to be determined prior to the calculations [PENG, Y., LIANG, L., TAN, J., SHA, J., XIE, G., 2015].

%Ash rejection= $(1 - \frac{(wC\ Ac)}{(WfAf} \times 100$ ………………………………**Equation4**

Where,

Ac= Ash content of clean coal

AF= Ash content of feed

WC= Mass of clean coal

Wf= Mass of feed

%Combustible recovery= $[\frac{Wc,daf}{W,fdaf}] \times 100$.....................................**Equation5**

Where,

WC, daf= Mass of dry-ash free clean coal

Wf, daf= Mass of dry-ash free feed

WC, daf=WC (100-(m + Ac))/100……………………………………**Equation6**

Wf, daf=Wf (100-(m + Af))/100……………………………………..**Equation7**

Where,

M is the average moisture amount of coal,

WC, da= Mass of dry-ash free clean coal

Wf, daf=Mass of dry-ash free feed

Weight of coal in the tailings was also calculated from

Wt=wf-wc

Where,

Wt=weight of coal in the tiling

Wf=weight of coal in the feed

WC=weight of coal in the concentrate

Another quantitative figure „Efficiency Index of Flotation Cell" was also useful in determining the effect of variables and the efficiencies. Mathematically it is given by

Efficiency index = (%AR+%CR)-100…………………………………**Euation8**

Table2: Calculation for Effect of Particle Size in Coal Slurry:

No	Particle size range (μm)	Wf (g)	Wc (g)	Wt (g)	% Af	%Ac	% AR	Wf,daf (g)	Wc,daf (g)	%CR	EI
1	-180+100	95	42.4	52.6	31	15	78.5	60.8	33.92	55.79	34.29
2	*-225+180*	95	*44.43*	50.6	31	14	78.8	60.8	*35.98*	*59.18*	*37.98*
3	*-350+225*	95	45.22	49.9	31	13	80.0	60.8	*37.08*	*60.99*	40.99
4	*-500+350*	95	41	53.9	31	15	79.1	60.8	32.8	*53.95*	33.05

4.2. Discussions

4.2.1 Effects of particle size on coal floatation

The coal's particle size distribution is one of many variables that affect froth flotation efficiency. Numerous research projects have extensively examined the impact of particle size on froth flotation's ability to clean coal. It has been found that froth flotation's overall effectiveness is significantly influenced by particle size. The better release of coal from contaminants due to the reduced particle size results in improved coal recovery. However, because there is a greater chance of coal loss and a higher expense for regrinding, the finer particles also have a tendency to make the process more complex. On the other side, bigger particle size results in a simpler process, but at the expense of reduced coal recovery due to ineffective coal-impurity separation.

The optimum particle size range for froth flotation coal cleaning is therefore the most important factor in achieving maximum efficiency and cost effectiveness. There are several studies that have been conducted to identify the optimum particle size range froth flotation for coal cleaning. The optimal particle size range has been found to be +180µm to -225 µm. Within this particle size range, froth flotation efficiency is maximized and coal recovery is more significant. In this project, the unit retention learning has been studied taking fractions from -500µm+350µm,-350µm+225µm,-225µm+180µm and -180µm+100µm. The ash rejection, the combustible recovery and the efficiency index decreases when fraction size increases. When we look at ash rejection, the ash recirculation and the efficiency index is between -180µm and -225µm and it is clear from the fraction of -180µm+100µm. More than -225µm+180µm, it shows that the fractions add up. It also shows that increasing the particle size of coal reduces the weight of coal concentrate.

The influence of the particle size on the concentrate ash and combustible recovery the coarse size fraction (+350 µm) yielded the lowest ash content and combustible recovery. The combustible recovery from the intermediate size fraction (-350+225) in was much higher than that from the coarse and the fine (-225µm+180µm) size fractions.

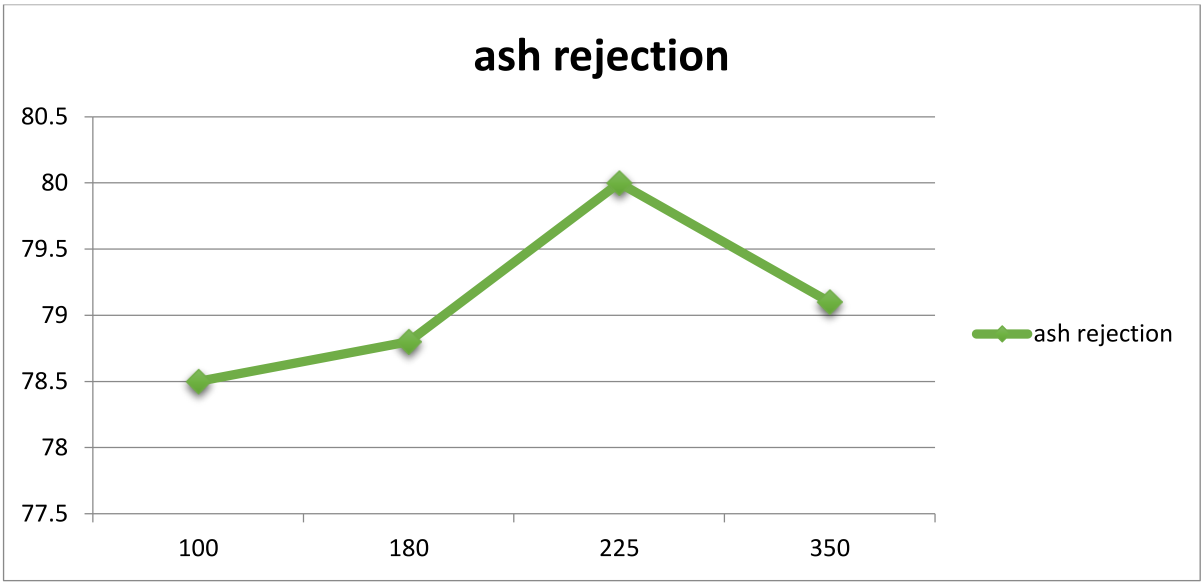

Figure5. %Ash rejection vs particle size (µm)

It can be seen from Figure 5 that the ash rejection, increases as the coal particle size increases. However, the direct correlation between the coal particle size and ash rejection shows that the coal particle size can reach the optimum particle size range. After the coal particles reach the optimum particle size range, all parameters such as ash rejection, are going to decreasing as the particles increasing.

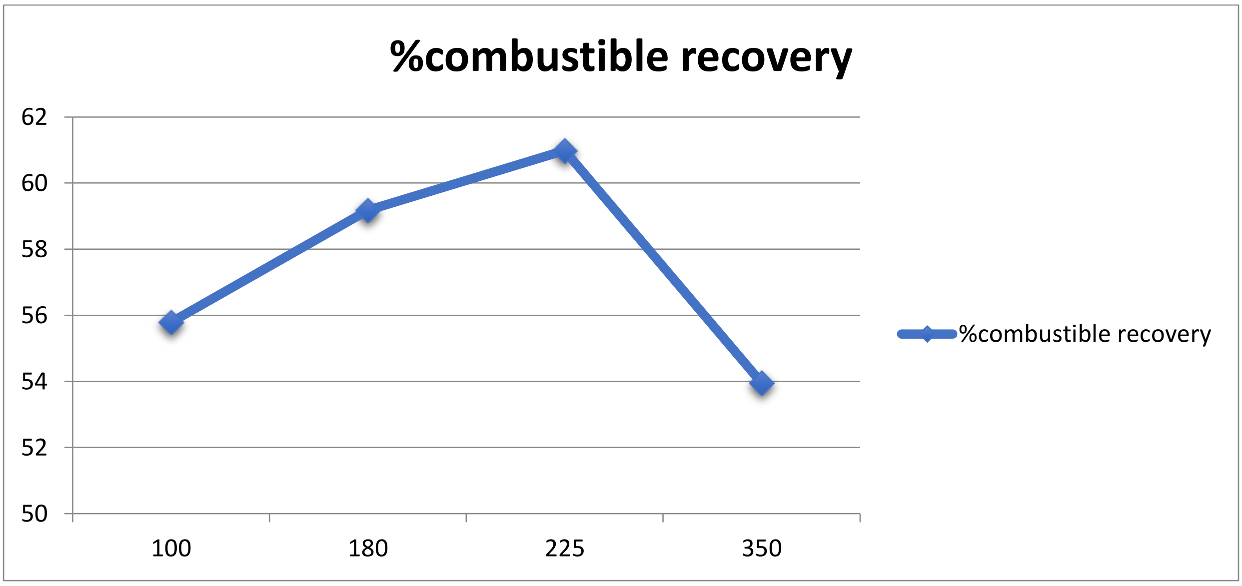

Figure6. %Combustible Recovery vs. Particle Size (µm)

It can be seen from Figure 5, which the combustible recovery increases as the ranges of coal particle size from +100 up to -225 increases.

However, the direct correlation between the coal particle size and combustible recovery shows that the coal particle size can reach the optimum particle size range. After the coal particles reach the optimum particle size range, combustible recovery are going to decreasing as the particles increasing.

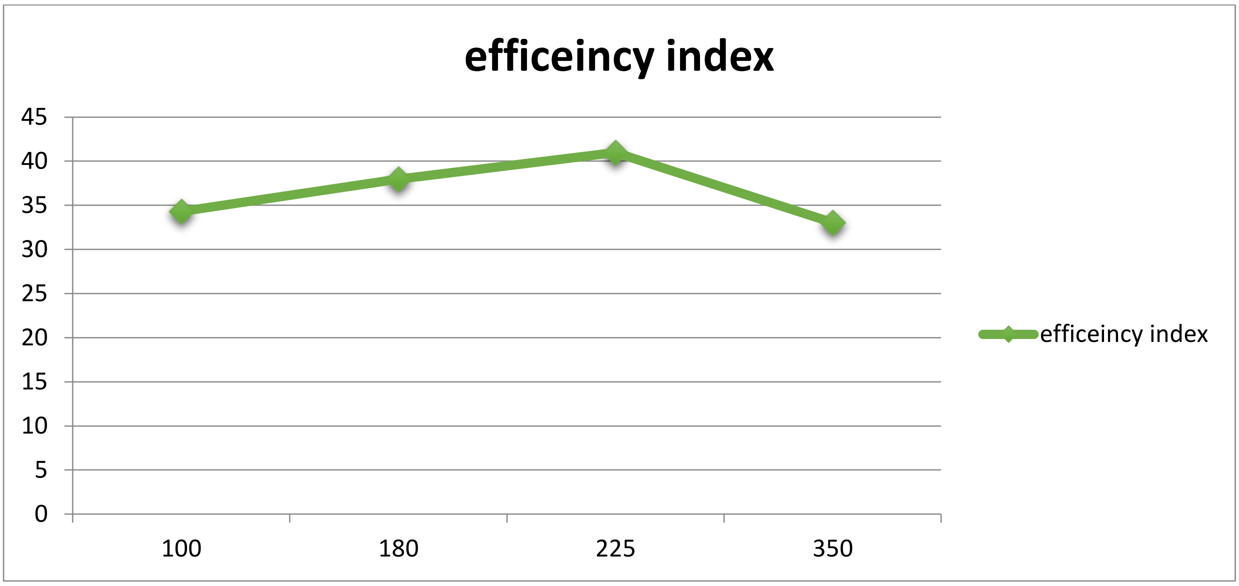

Figure 7: Efficiency index vs. particle size (µm)

It can be seen from Figure 6 shows that efficiency index increases as the coal particle size increases. Co relationship between efficiency index and particle size of the coal is inversely preoperational after the particle size can reach the optimum particle size range.

CHAPTER FIVE

CONCULUSION AND RECOMMONDATION

5.1 Conclusion

In conclusion, the particle size of coal plays a vital role in the efficiency of froth flotation as a cleaning technique. The results of this study show that from the ranges of +180µm-225µmof coal particles size produce more combustible recovery, ash rejection and efficiency index than above -500µm+350mµ coal particles sizes. This is due to the higher surface area of the fine particles, which increases the number of active sites for the adsorption of flotation reagents. The flotation recovery of fine particles is also higher due to the higher probability of attachment to air bubbles, resulting in a cleaner coal product. However, the flotation of fine coal particles requires more energy, time, and reagents compared to larger particles. This cost could be a significant challenge for large-scale industrial applications. Nevertheless, the results of this study provide useful information for designing and optimizing the coal cleaning process. The optimum particle size range for efficient coal cleaning by froth flotation should be carefully selected based on the balance between the product quality and the production cost.

In general the particle size distribution of coal has a significant impact on the efficiency of froth flotation for coal cleaning. Proper optimization of the particle size range can help in achieving maximum coal recovery and cost-effect for the coal cleaning process. Therefore, further studies on this topic are necessary to improve the overall efficiency of the coal cleaning process.

5.2 Recommendation

- The results of this study provide useful information for designing and optimizing the coal cleaning process.
- The optimum particle size range for efficient coal cleaning by froth flotation should be carefully selected based on the balance between the product quality and the production cost. Based on this research, my suggestion in the future is if the effects of coal particle size are paid attention to the industrialists who want to clean coal using flotation method.

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