DEPARTMENT OF NANOSCIENCE TECHNOLOGY

FACULTY OF TECHNOLOGY

WAYAMBA UNIVERSITY OF SRI LANAKA

INDUSTRIAL TRAINING REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE DEGREE OF BACHELOR OF ENGINEERING TECHNOLOGY HONOURS

INDUSTRIAL TRAINING

AT

BOGALA GRAPHITE LANKA PLC

BOGALA MINES, ARUGGAMMANA RD, 71041, SRI LANKA

WITH THE COORDINATION

OF

NATIONAL APPRENTICE AND INDUSTRIAL TRAINING AUTHORITY

(10th July 2023 To 07th January 2023**)**

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1. **Shaft** : A vertical underground opening which is driven through the rock.
2. **Cross Cuts** : Pathways driven to reach the vein from shaft or other underground opening.
3. **Drive** : Horizontally driven pathways along the graphite vein, starting from the crosscut.
4. **Winze** : Pathways driven through the graphite vein from top level to bottom level.
5. **Raise** : Pathways driven through the graphite vein from bottom level to top level.

CHAPTER 1 : INTRODUCTION TO THE INDUSTRIAL TRAINING ORGANIZATION

1.1 Introduction

A company called Bogala Graphite Lanka PLC is situated in Sri Lanka and works in the mining, separating, purifying, managing, processing, and manufacturing of lubricants as well as graphite in different dimensions and selling it. The company sells Different sizes (lumps to micron powders) customized goods, and carbon (80% to 99%). Carbon brushes, foundries, dispersions, chemical applications, refractory, polymers, friction, pencils, powder metallurgy, and batteries are just a few of the uses for its goods. It provides premixed graphite powder and finished graphite dispersions, as well as graphite pieces in a variety of geometric shapes. Expandable graphite is used to add flame-retardant qualities to plastics. The Company exports its products to countries, such as the United States, United Kingdom, South Korea, Japan, India, Pakistan and Germany. For more than 150 years, Bogala Graphite Lanka PLC has been Sri Lanka's leading producer and exporter of vein graphite to the global market. This is an underground mine that descends to a depth of roughly 500 meters. AMG Graphite Kropfmühl group of enterprises in Germany owns Bogala Graphite Lanka PLC as one of its subsidiaries. It operates five subsidiaries globally. (Figure 1)

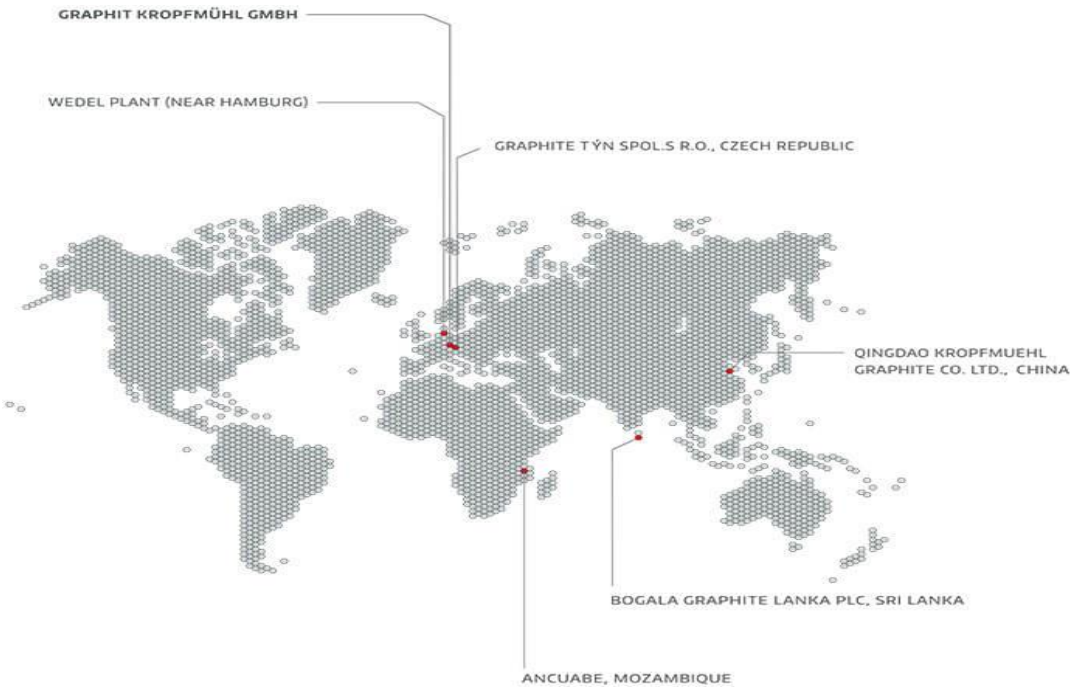


Figure 1.1 - Subsidiaries of AMG Graphit Kropfmühl Group of Company

1.2 GK Group

Graphite Kropfmühl GmbH is a long-established company with over 140 years of experience as a reliable supplier of high-quality grades of graphite. During the last two decades, they have developed from being solely a producer of raw materials to an international stock exchange quoted specialist graphite company with a wide product range. Recently this product range has been further extended and now also includes silicon metal.

Primarily they consider themselves as a raw-material refining company developing specialized products using high-technology processes and serving the needs of our customers by being close to our markets. One of our most important functions is ensuring the continuity and consistency of raw-material supplies, and in achieving this goal we have acquired stakes in secured and controlled graphite deposits in Africa, Europe and Asia.

Not only that they are doing graphite base lots of research and they have been succeeding in several projects' graphite lubricants, conductive inks, expandable graphite, crucibles and refractory materials, brake linings, carbon brushes, powder metallurgy, batteries and fuel cells, and polymers.

Figure 1.2 - Logo of the GK Group

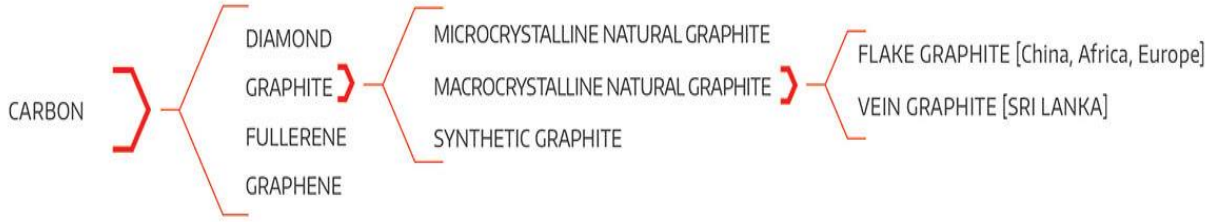


Figure 1.3 – Carbon structures

1.3 Origin and crystal structure of graphite

The glossy, anthracite-coloured mineral that English shepherds discovered in 1565 was dubbed "plumbago" by them. This was discovered long after the Celts, who had already employed graphite to make ceramics. A Swedish chemist only realized that this substance was a form of carbon and not lead in 1779. The Greek term for "to write," "Graphein," is the source of the name that is currently in use. Graphite is completely safe, environmentally benign, and chemically inert. It is divided into two categories: synthetic graphite and natural graphite, both macrocrystalline and microcrystalline. The fundamental building block of a graphite crystal is six carbon atoms arranged in a hexagon. Although the two-dimensional lattices are extremely stable when shifted against one another, they are nonetheless easily shifted within one another. Six hexagonally organized carbon atoms make up the fundamental building blocks of the graphite crystal, which are two-dimensional lattices with mutual interaction. Because of its unique qualities resulting from its crystal structure, graphite is a raw material with a wide range of applications.

Excellent electrical and thermal conductivity, exceptional lubricating qualities, strong resistance to temperature and oxidation, and the capacity to generate intercalation compounds are the qualities that make the "black gold" suitable for a wide range of applications.

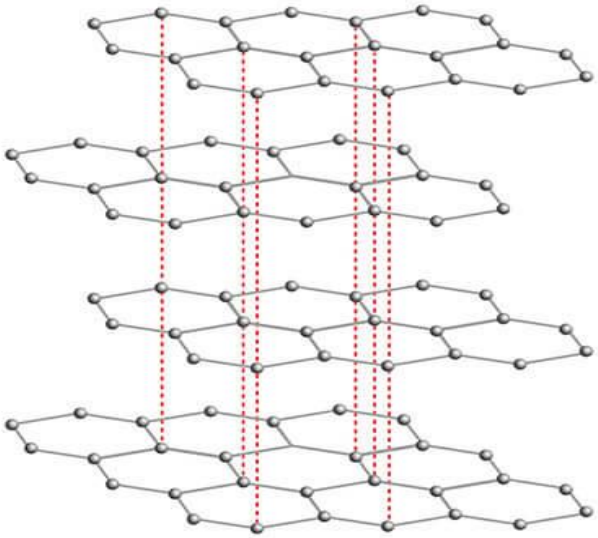


Figure 1.4 – Crystal structure

1.4 Company History

Based on a graphite deposit found in the Aruggammana area of Kotiyakumbura, the literary records indicate that the Bogala graphite mining was initiated in the first half of the 19th century. The notes from the Governor's journals indicate that graphite mining began around in 1847. The mine had three primary open pits by 1860: "Punchi Bogala," "Maha Bogala," and "Karadawatta." The mines had been registered with the government in 1865.

Originally connected by subterranean passages, three pits were separated over time by labour disputes that caused "Maha Bogala" to shift the direction of the water flow toward "Punchi Bogala," which caused the latter to flood. Ownership of "Punchi Bogala" was passed to "Maha Bogala" in 1920, and in 1947 "Karadawatta" mine was annexed by "Maha Bogala," which was then referred to as "Bogala Mines."

In 1972, the State Graphite Corporation was established by the government after Bogala Mine was taken over as part of the nationalization of Sri Lanka's mining industry. In order to incorporate additional minerals into this cooperation, the State Mining and Mineral Development Corporation of Sri Lanka was the new name given to the institute in 1982. In March 2000, Graphit Kropfmühl AG of Germany acquired the majority of the shares of the Bogala mines, which are a subsidiary of Advanced Metallurgical Group N.V. (AMG Graphite), a company that aims to create and apply innovative metallurgical solutions for the sustainable development of natural resources and to reduce CO2 emissions. The mine was first privatized in 1991 under the ownership of Bogala Graphite Ltd.

Figure 1.5 - Historical Photograph of the Bogala Mine

1.5 Location

The training establishment, Bogala Graphite Lanka PLC, is situated in the Aruggammana area in the Kegalle district. (Figure 3)

- Location coordinates - 7.11653 N, 80.30958 E
- Address - Bogala Graphite Lanka PLC,
  Bogala Mines 71041, Aruggammana Rd,
  Sri Lanka

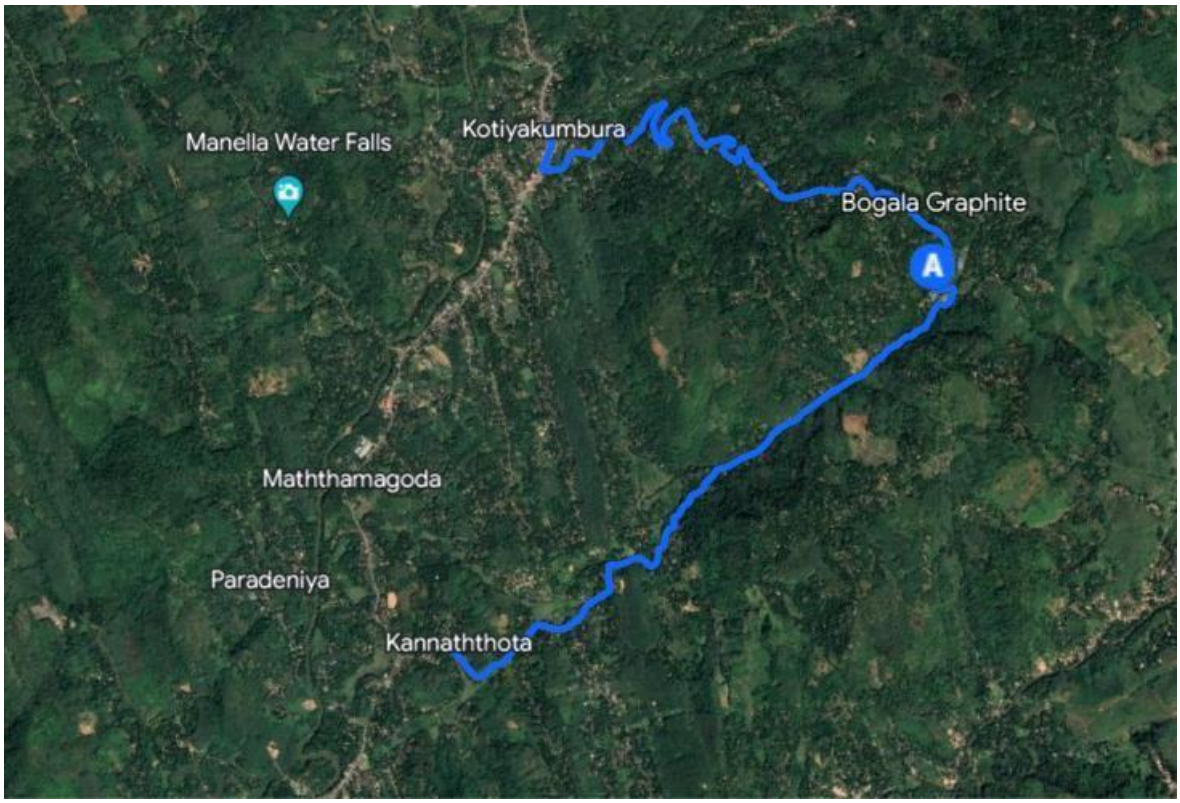


Figure 1.6 - Location of Bogala Graphite Lanka PLC

1.6 Types of Graphite in Bogala Mine

The graphite of the Bogala mine can be classified into three groups based on its physical properties and appearance.

Figure 1.7 – Graphite types in Bogala Mine

1.7 Products and Applications

A wide range of products are being manufactured at Bogala Graphite Lanka PLC, which include lumps, chips, powders, expandable graphite, graphite dispersions and graphite parts, and concentrates. (Table 1)

Product	Particle Size
Lumps	+ 10.0 mm
Chips	
▪ Chippy Dust	5.0 mm
▪ Bold Chips	5.0 - 1.7 mm
▪ Fine Chips	1.7 - 0.5 mm
Powders	
▪ Normal Powder	150 µm
▪ Other Powder	75 µm
▪ Micron Powder	100 - 40 µm
▪ Very Fine Powder	20 µm
Concentrates	106.0 µm
Dispersions	-

Table 1.1 - Products at Bogala Graphite Lanka PLC

- Friction Linings
- Lubricants
- Chemicals
- pencils
- Formed Parts
- Dispersions
- Batteries and fuel cells
- Gasket
- Refractory Products
- Flame Protection
- Powder Metallurgy
- Refractory Products
- Crucibles
- Carbon Brush
- Drywall panels

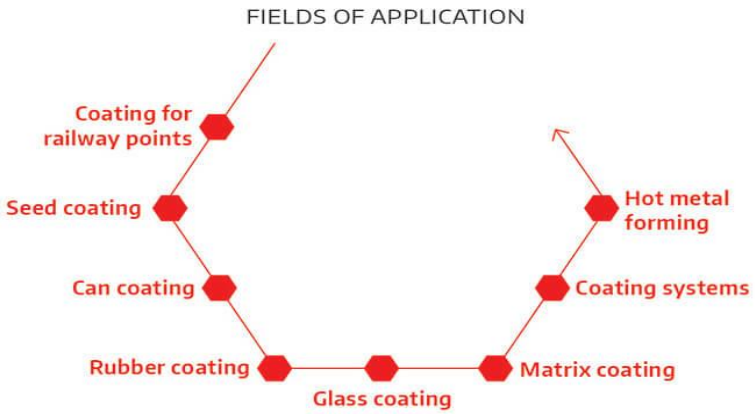


Figure 1.8– Fields of application

1.8 Integrated Management System of the Company

Bogala Graphite Lanka PLC commits to excellence in quality, environmental protection, safety, health, security and sustainability in their mining operations as well as in the community. In our mining operations and in the community of which are a part whilst adhering to ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 , Occupational Health and Safety (SLS ISO 45001:2018).

1.9 Organization Hierarchy

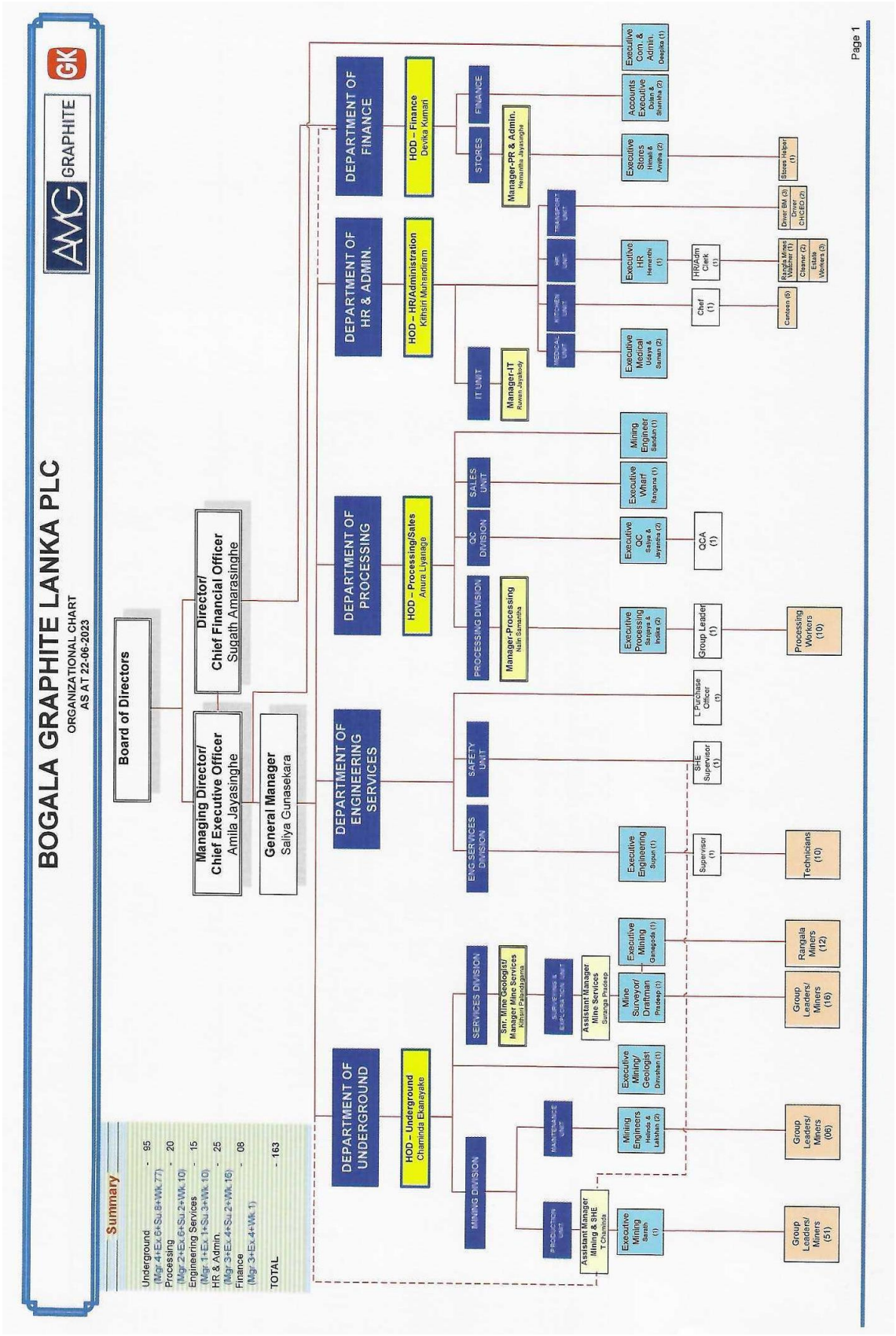


Figure 1.9 - Hierarchy of the Bogala Graphite Lanka PLC

1.10 SWOT analysis

1.10.1 Businesses, organizations, and people utilize SWOT analysis as a strategic planning technique to assess their opportunities, threats, weaknesses, and strengths. The analysis assists in determining the external (opportunities and threats) and internal (strengths and weaknesses) elements that may have an impact on the entity's performance in the future or its current state.

1.10.2 Strengths

- More than 150 years they have been involved in graphite mining, processing, treating and exporting.
- Bogala Mines has an experienced skilful manager, mining engineers and surveyors, workforce with expertise in underground mining.
- The purity of vein graphite in Bogala Mine is more than 99%.
- Bogala Mines has a strong financial position.

1.10.3 Weaknesses

- In sorting, the section uses the hand sorting technique, so it degreases efficiency since it is time-consuming.
- Still do with old techniques of graphite mining ,so its time consuming.
- Sometimes in management level have low idea about the practical situations of the underground and low number of full-time supervisors.

1.10.4 Opportunities

- Since Sri Lankan graphite has a good world market Bogala Graphite Lanka PLC can spread their products to the world.
- Alternatives for petrol cars future use electric vehicles (EV) batteries graphite needed for it.
- Bogala Mines have good reputation by implementing new products for market.
- Bogala Graphite Lanka PLC has a great opportunity to increase its graphite production by using the Rangala mine and having high purity graphite degrease processing cost
- Bogala Graphite Lanka PLC has a great opportunity to make value-added graphite production since having processing plants.

1.10.5 Threats

- Companies that mine graphite, such as Kahatagaha, may compete with one another for sales.
- Future changes in government rules and regulations could provide challenges or increase the cost of operating Bogala Mines, such as increased electricity costs, material costs for maintenance, and tax rates.
- Bogala Mines would be caused by natural calamities, synthetic graphite, and economic downturns.

CHAPTER 2 : TECHNICAL EXPERIENCE GAINED DURING INDUSTRIAL TRAINING

2.1 Department of Underground

The Bogala mine is made up of four main shafts: Gabriel, Karadawatta, Ventilation, and Malalasekara shafts. The Gabriel shaft is open from 72 fathoms (FM) down to 275 FM, while the Malalasekara shaft is open to the surface and terminates at FM 72. In the present, these two shafts are used as routes for the transportation of personnel and goods.

The overhand cut and fill mining technique is used in Bogala mines because it has been shown to be an effective technique that yields excellent recovery rates. Stopes that are two meters high are cut from the bottom here. The first stope's floor will now be the drive's stable roof. The first stope's roof becomes the second stope's floor when it is cut. Starting at the third stope from the bottom, the filling is done. Here, the stope is blasted onto the second stope during backfilling after the panels on the third stope floor are removed. The first stope is left vacant and does not receive this backfilling. This serves as a safety precaution and a secure area for the unsteady, overfilled second stope. Additionally, the room and pillar approach are used in areas that are not supported. The rock is blasted next to the ore when the vein is too tiny to blast separately. In this case, a revolutionary device that used a waterjet to remove the mineral from nearby rock is currently in use.

Figure 2.1 - Mine vein location

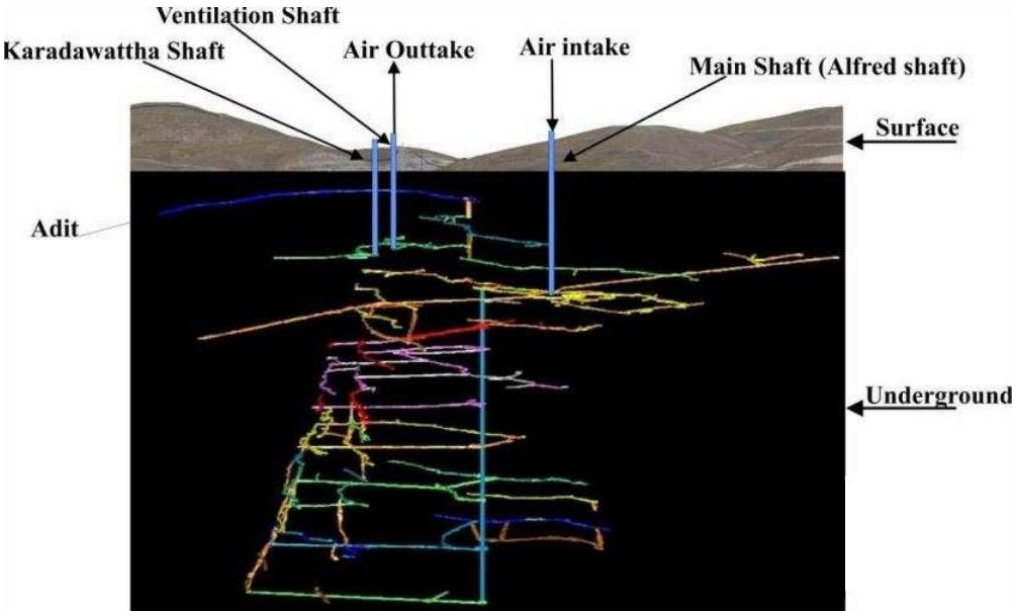


Figure 2.2 - Mine Structure

2.1.1 Geology

It is hard to portray geographically and different speculations of the birthplace of vein graphite. There is no accurate meaning of the event of graphite in Sri Lanka. A large portion of geologists accept the event of vein graphite as a consequence of aqueous arrangement. Carbon dioxide and CH_4 in a magmatic supercritical liquid in the middle of the road or low fugacity of oxygen may have responded with one another to frame epigenetic graphite. As indicated by the response occurring in an H_2O-overwhelmed liquid, as follows,

$$CO_2\ (g) + CH_4\ (g) \rightarrow 2\ C\ (gr) + 2\ H_2O\ (g)$$

Thermodynamic calculations show that graphite precipitation is possible in the P-T regime in the deep crust. High temperature and high pressure increase the probability of this reaction and lead to well-crystallized graphite.

Sri Lanka is renowned for its exceptional, premium vein graphite, which ranges in purity from 95% to 99%. The vein graphite deposits in Sri Lanka are found as solidified fillings of hydrothermal fluids in rock fractures and cavities, in the axial traces of antiforms and synforms in Precambrian high-grade metamorphic terrain. Many gangue minerals, including as quartz, Na-K-feldspar, clinopyroxene, pyrrhotite, pyrite, chalcopyrite, sphalerite, biotite, calcite, siderite, and dolomite, can be distinguished among the 95% high-quality graphite. According to research, vein graphite mineralization in Sri Lanka is

interpreted as related to crystallization from magmatic solutions containing Si, P, Cl, F, Fe, Mg, Zn, Ti, K, Ni, Co, Cu, CO2, H2O and CH4.

With special attention to the Bogala mines, the deposit is mineralized along the antifoam structure and is composed of several minor and three major vertically dipping graphite veins. The major veins are Kumbuk, Na, and Mee; the minor veins are Kumbuk split, Kumbuk off, Aswadduma, and Katawala. Main graphite veins extend horizontally between 130 and 300 meters, with thicknesses ranging from 0.28 to 0.98 meters.

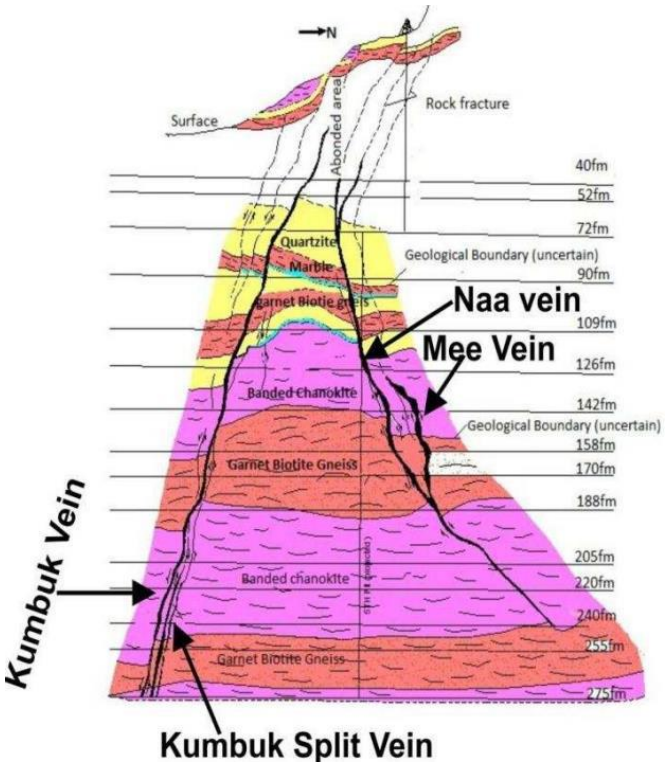


Figure 2.3 - Vein Types of Bogala Mine

2.1.2 Mining Cycle

Considering an ore block, it is bounded by two drives on top and bottom, and two winzes on sides. The stope is initiated from a lower level to an upper sub-level, the ore haulage is done using an ore chute. There are 4 main stages in the process; Drilling, Blasting, Supporting, Mucking.

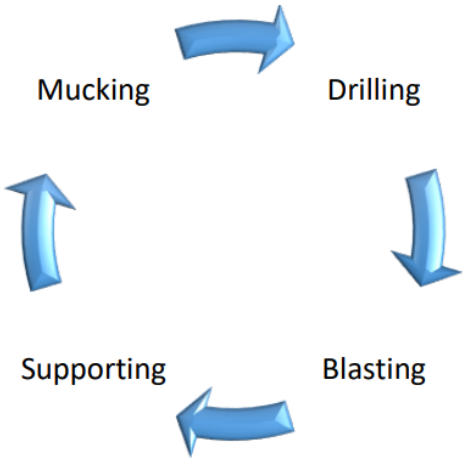


Figure 2.4 - Mining Cycle

2.1.3 Communication system

In underground works communication was done by using bell system for signaling as bellow. And there is standard amount of people can raise or go underground through shaft. And there is shaking system which goes underground and CCTV for observing and to make easy for shaft operation.

Figure 2.5 –Communication Signal board

2.1.4 Rangala mines

Rangala mines also belongs to the Bogala graphite Lanka PLC. Both graphite extracting works and exploration works are simultaneously conduct in the Rangala mines. Rangala mine is operated by three horizontal adits. Although it was identified that deposits

at the Rangala Mines contained high purity graphite, the mine remained closed and was not operational for many years. However, under the ownership of Bogala Graphite Lanka PLC, the mine has restarted its operations and currently carrying out mining and exploration activities. Newly exposed, comparatively large vein at the surface level above the top adit contains the highest purity we have ever experienced. The Geological Survey and Mines Bureau confirms that the samples from this vein are 99.98% pure. We are working on developing an exploration trench to confirm the strike of the vein mentioned above.

Figure 2.6 - Middle Adit of the Rangala Mine

2.1.5 Underground works

In the first date of Bogala Lanka PLC which is 10^th of July 2023. Got instructions about safety in work place, introduction about Bogala Graphite PLC and importance in PPE equipment's and also got working kit, gloves, googles, earbuds, Socks, boots, helmets and head torch. Got lots of instructions about PPE and its nessarcity. Next day, visited underground field with a supervisor and got a brief idea about underground mining graphite and also earned how to use the lift and safety in it. Learned about cycle method and emergency exits in underground. Third day, worked on 302M level E8 work place and job is to make a Drive and Cleaned the blasted area and removed blasted rocks. Watered the rock to check whether there are any cracks in outer area and removed. Next day, connected a rail track by bending the tracks and pined and Level the land and connected the tracks one another by checking distance between two wheels on cart (2.2feet). Then checked by moving an empty cart moving on it. After that drilled the rock by using drilling machine which is operated by compressed air. Friday worked on drilling rocks to put blasting agents, prepared to blast the rock which was not blasted through earlier blast by using water gel and ammonium. Then covered the hole by clay and cloths to prevent blasting agents coming out. Then upstairs on the drive to remove a rock which cannot be blasted by explosives are removed by using crack stone chemical mixing with 1.5L of water to 5 kg of chemical. Last day in this week, after the blast area was cleaned by using rail cart which was blasted in

previous day, and also put rock cracking chemical to second layer and removed first layer in it.

In Short, in this week, as an industrial trainee at Bogala Lanka PLC. I got some idea about different sectors and special knowledge about underground mining cycle process which is above mentioned. And experienced the value of PPE equipment's and personal safety. And also trained equipment's used in underground mining and working process. I have participated on a cycle in 304M level and trained processes like drilling, anchors placing, rail tracks placing, placing explosives, blasting and wood placing for upper level mining, chemical mixing and pouring for rock cracking are processes experienced in this week.

Problem faced and Solution in this week on rocks were not blasted due to hardness of the rocks and using a smaller number of explosives and the solution was drilling the rock decreasing the distance of holes and using more explosives. Unable to use explosives due to bad positioning of the rock so solution was to use rock cracking chemical to crack rock.

Figure 2.7 – Cracked stones due to expansion by Crack stone chemical

In Second week, worked on underground 416m sublevel 446m 12A work place and to maintain abandon drive and separate graphite and stones separately. And also got the graphite separately into a cart and use the hammer machine. Next day, use explosives for less blasted parts and blast those and also make the floor clear to place wood and rails. Then learn to operate the winch which is operated by air, And Watered the rock to check whether there are any cracks in outer area and remove. Third day, drilling for the anchors and placing those in rock and use the drilling machine. Then measured the length between the anchors, Place the iron and wood in repairing drive. Next day, connected iron rails on top and extended the rails further and use rail bending clamp and bend two rails similar to each other. Then operated the winch and place the wood on the top. Friday, in this week on repaired the abandon winch by placing the wood and repaired the ladder. And cut the wood into required shape and length. Last day in this week, Place the wood on another stage and place the new

anchors and replace the decaying wood to new. After that, place the wood on the door of the winch and cover the remaining. And fixed the door by placing the nails check whether.

This week's summary, as an industrial trainee at Bogala Lanka PLC. I got experienced on winch operating measuring placing. And also trained equipment's used in underground mining and working process like hammer and driller. I have participated on a repairing old sublevel winze and ladders and trained processes like drilling, anchors placing, rail tracks placing, placing explosives, blasting and wood placing for upper level mining, and wood replacing for old wood are processes experienced in this week.

Problem faced and solution in this week on Hammering by machine which cannot be removed by iron rod, and Unable to place the anchors due to bad positioning of the rocks and so used long rod anchors instead of short ones.

Figure 2.8 – Anchor placing

First day of third week, drilling the rock for rock Bolt in strolling, and placing the net on to rock and in strolling the rock Bolt for to prevent rock sliding down. Second day in worked on new work place at 222M which is graphite vain. And also collecting the graphite which was blasted earlier and watering the rocks and graphite which was blasted to check whether is there any cracked rocks or graphite. Next day, placing the rock Bolt for to keep the graphite bulk to the stones to stop sliding down, and drilling the graphite to blast by using water gel and ammonium. Next day, placing the anchors to take the measurements to place iron rail and placing those iron rail. Then made the roof by in strolling the wood on the top and filling the carts by graphite. Fifth day, measuring graphite processing area and getting rough knowledge about processing machines and got some knowledge about graphite purification. Last day of third week, filling stones to carts which were blasted and placing the anchors, blasted the area which were not blasted previous day.

In short, in this week, as an industrial trainee at Bogala Lanka PLC. I got experienced on Rock Bolt placing and also trained equipment's used in underground mining and worked on process like graphite blasting and hammering. I have participated on a rock Bolt placing for large rocks or graphite which were cracked and trained processes like drilling, anchors

placing, placing explosives, blasting and wood placing, net placing, and wood replacing for old wood are processes experienced in this week.

Problem faced and Solution in this week on, when drilling for to place rock Bolt of 5 feet drilling rod was stucked due to pushing too much when drilling so it should be drilled by giving less amount of force and also one line of the blast hasn't blasted due to suppling of electric spark for two blasting places once so it was blasted later.

Figure 2.9 – Driller used to drill rock

On the first day of the fourth week, worked on 222m underground level and blasted the rocks and anchor placement and also separated the graphite and stones. Next day, continue a survey in processing area and got the measurements in 2 stages in processing area. After that draw the plan using AUTOCAD. On the following day, worked on explosive room and learned ammonium patching after mixing with diesel 1L of diesel to 13 kg of ammonium and packed ammonium by putting 100g for one. And prepare caps which blast according to time difference in 25ms. After that work on electrical winze operation and studied its mechanism and went for a visit to workplaces with some visitors in underground and explained those extracting techniques. And the last day of this week, Emergency exit maintaining in level 192m. And also, in this ladder repairing and wood placement was done.

This week's summary, as an industrial trainee at Bogala Lanka PLC. I got experienced on anchor placing, explosive preparing, saving, electrical winze operating. And also trained equipment's used in underground mining and worked on process like blasting, drilling and importance of emergency exits. I have participated on explosive preparation which is ammonium mixing with diesel in 1L to 13kg of ammonium. And trained processes like drilling, anchors placing, placing explosives, blasting and wood placing, and wood Replacing for old wood are processes experienced in this week.

Problem faced and Solution in this week, when emergency exit maintaining should use two ladder lockers to maintain strength instead of one. When wire connecting with blasting cable should not touch iron or electricity conducting material because it will minimize going electricity to blasting cap.

Figure 2.10 – Detonators used for blasting and shot exploder

On the first day of the Fifth week, participated for a cycle in level 275, separation of graphite and stones on upper level and filling one side with stones and graphite was put on an ore pass to collect those in a cart. Next day, placing explosives other drilling and got graphite through ore pass was done. And also place wood on the up of workplace, anchor placing and place iron on the up as done and cycle was completed that day. Next day, participated for placing explosives in level 275 and anchor placing and wood placing. In short, I got experienced on anchor placing, explosive placing separating graphite and stones and putting graphite to ore pass and filling carts from out pass was the techniques trained in it. And trained process which are related to cycle as blasting, drilling anchors placing, and wood placing. And importance of emergency exits are the processes experienced in this week.

Problem faced and Solutions in this week, to keep the safety near are pass on the up we used a mesh otherwise walking near ore pass in out good for safety, and we got priority to keep safety in work station so we pub wood on the up before getting graphite.

Figure 2.11 – Overhand cut and fill method

In six weeks, participated for a survey to draw some Colum in floating area. And second day in this week on participated for to draw cross sections of floating area, third day, participated for to cross sections of floating area. Next day, participated for waterjet machine to extract graphite, and also Drilling the rock to place anchor and place iron rail on it. Next day, went to maintains with gang I to replace a long tube to water line to pass water on it, and place clamps in different areas to catch the tube. Last day in this week, visited the underground winze to show some visitors operating techniques, also explaining the Gabriel shaft, emergency exits and shaft operation to visitors on level 72.

This week's summary, as an industrial trainee at Bogala Lanka PLC. I got experienced on waterjet machine. And also trained equipment's used in underground mining and maintenance. I have participated on long tube placing on another place in underground and also clamps placing on that tube are process experienced in this week.

Problem Faced and Solutions in this week, when connecting long tubes should use clams to catch extra weight because when passing water or air in high pressure can damage the tube. When explaining underground processes to visitors we used simple words inserted of complex words.

Figure 2.12 – Rail track bending by using clamp

On the first day of the Seven week, moved to level 240 service station where the job is to separate graphite and stone and fill them in separate carts. Replacing a broken wooden beam with an iron rail on top. Next day, separated the down tunnel into two areas with wood and laid a mesh in it. After that Cut and fill method was done in hear by putting stones into filling side of the race and also graphite was filled to cart from other side. Third day, placed diamond drilled stone boxes in order to separate places, and got a lecture and some papers about geology and got knowledge about mine starting procedure not only that, read some papers about graphite categorization. Next day, went for same work place and anchor placing, drilling was done. At the end explosive placing and blasting was done after fixed time. Next day, Sorting graphite and stones separately and put graphite into cart and stones

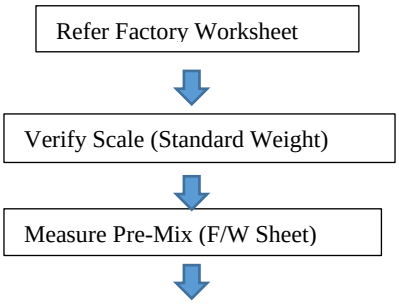
into separated area.In short, in this week, as an industrial trainee at Bogala Graphite Lanka PLC. I got experienced on some geological methods of starting a mine and about diamond drill machine. And also trained equipment's used in underground mining and worked on process like blasting, drilling and hammering. I have participated on processes like drilling, anchors placing, placing explosives, blasting and wood placing, net placing, and keeping diamond drilled stone boxes in descending order are processes experienced in this week.

Problem and solution in this week, when placing stone boxes of diamond drill, we kept in descending order to make easy for to note lengths of graphite deposits and separating the stone filling area with wood should done accurately since when race goes up it get more weight to those. Mesh placing prevents stone fall down and also it helps to catch it more strongly.

Figure 2.13 – Rail track placing to increase efficiency for graphite transport

2.2 Department of Processing

I involved ground-level operations, including work at the Dispersion plant and the Trommel Jaw Crusher plant. The primary focus was on dispersing Aqua net grades and processing graphite into different sizes. Learned how to operate various equipment, and conducted quality control checks on the dispersed material. The dispersion plant activities involved dispersing different Aqua net grades, sampling, and quality control analysis. Overall, the week was marked by efficient processing operations, quality analysing.



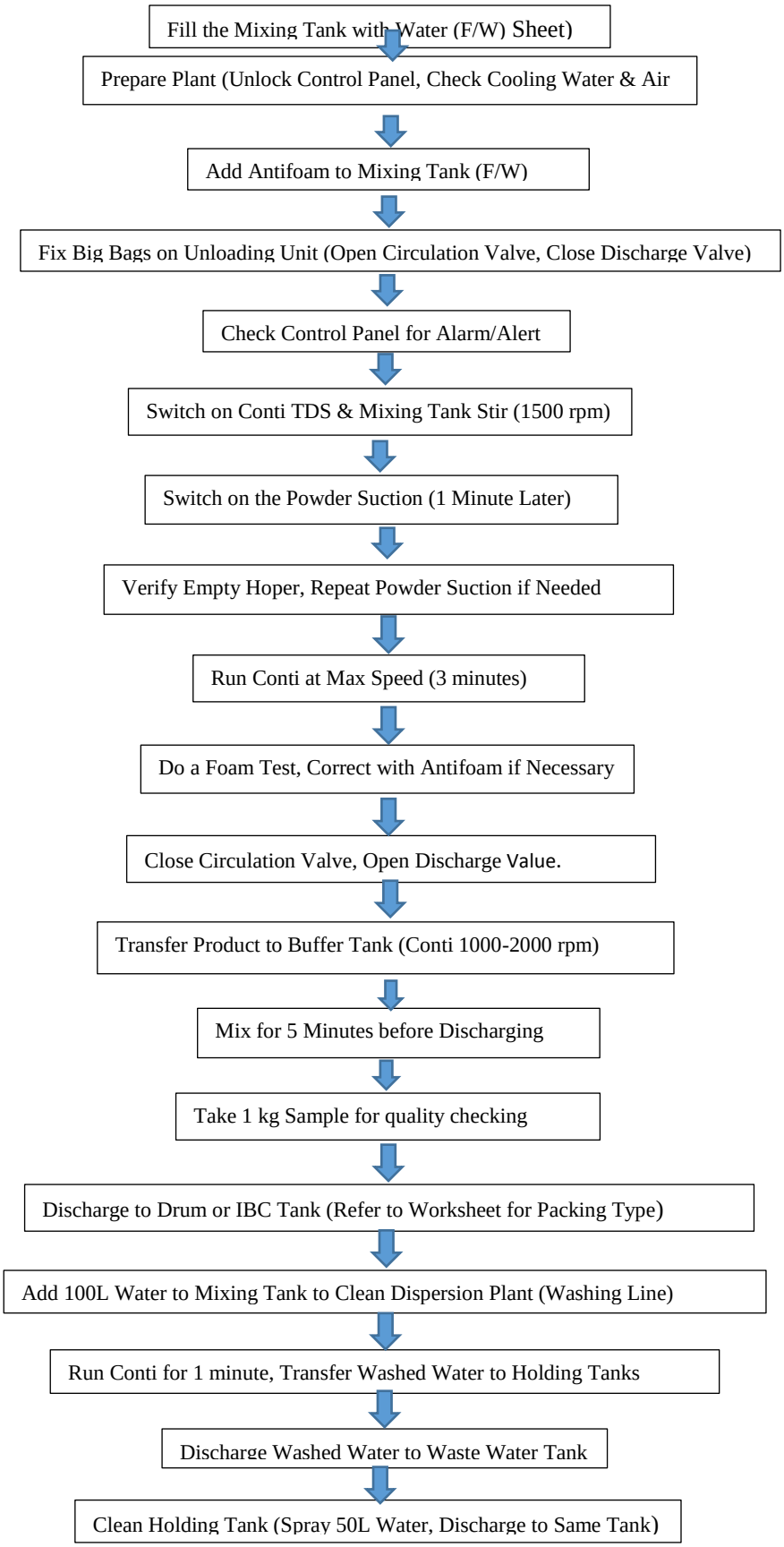


Figure 2.14 – Procedure of dispersion plant

In this ninth week, worked on surface operations, including work at the processing Dispersion plant and mesh replacements. The primary focus was on dispersing Aqua powder grades and making liquids according to factory work sheets. Learned how to operate various equipment, and conducted quality control checks on the dispersed material. The dispersion plant activities involved dispersing different Aqua powder grades, sampling, and quality control analysis. The maintenance of meshes, installation of new meshes was operations processing. Mainly we worked with commitment, efficiency, safety, and quality. Overall, the week was marked by efficient processing operations, quality analysing and mesh replacements.

Problem and solutions faced was when filling liquids for IBC tank or Drums. If there was an alarm for to indicate different mass in Balance will increase efficiency and accuracy.

Figure 2.15 – Liquid sample got from drums

In this tenth week, worked on surface operations, including work at the Graphite Hand sorting area other operators. The primary focus was to separate Graphite which process through jaw crusher to different purities as above 97%, above 92%, above 65% others as stones. Done graphite bag moving through overhead crane and got more practice through hand sorting of graphite. Mainly we worked with commitment, efficiency and safety. Overall, the week was marked by efficient processing operations and quality analysing.

Problem and solutions in this week were Identifying difference between 92% graphite and 97% graphite was little bit difficult, with the practice it was easier lately but at the first day I choose those with the help of operators.

Figure 2.16 – Sorting area and difference of graphite and stones

Then worked on surface operations, including work at floatation plant and Researches on rubber and graphite aqua powder grades. The primary focus was on the first two days in Research and development and rest of the days on floatation plant. Learned how to work on floatation plant process until Moisture removal process and drying. Research was on graphite usage in rubber tires and checking out effectiveness in it.

Worked on floatation plant in first date of twelfth week and got samples of de-watering and check moisture content of the sample as usual and got samples of shaking table. Then products were taken separately into 3 sample bags. Then Tuesday worked on packing area to transfer packages to containers according to necessary guidelines. worked on floatation plant and collect samples for to check carbon percentage of samples. Worked at shaking table and learned to control water flow rate, feeding rate. Then worked on floatation plant and repaired a liquid pump which is leaking. Participated for a meeting about future research on particle analysing in trommel output. Next day worked on floatation plant and help plant operator to collect samples and water level adjusting in floatation plant. worked on shaking table and got samples into 3 sample bags as product 1, product 2, and product 3 and sent for carbon check. In Friday worked on floatation plant, shaking table and collected samples then

checked moisture content of dewatering plant. package sealing was learned final day of week. Final products were sealed by using straps and then by covering polythene roles to make sure package is water proof.

In short, this week I engaged in surface processing operations including work at floatation plant and packing area. There I worked several aspects like sample collecting, controlling water flow, learned dewatering process, final product packing process etc. Learned proper way of getting samples and got randomly through different positions. When packing final product packed those properly with strips and glued with labels. And also, when loading big bags for containers put air-filled bags at the middle of those to stop crashing each other.

Figure 2.17 – Moisture analyzer

In the thirteenth week, I engaged in surface processing, operations, including work at floatation plant and packing area. There I worked covering several aspects like, sample collecting, controlling water flow, learned dewatering process, final product packing process etc. learned proper way of getting samples and got randomly through different positions. When packing final product packed those properly with straps and glued them with labels. And also, when loading big bags to containers we put air- filled bags at the middle of those to stop crashing each other. In this week fourteenth week, worked on surface operations, including work at floatation plant and Trommel sample collection. There worked on sample collecting, learned dewatering process, waterjet cart sampling process etc. Learned proper way of getting samples and got randomly through different positions. Mainly we worked with commitment, efficiency, safety, and quality. Overall, the week was marked by efficient processing operations, sample preparation.

In this fifteenth week, I worked on surface operations, which included sample collection, work at the drying yard, and the floatation plant. They practiced gathering samples, studied the procedure of dewatering, etc. I investigated various positions at random and discovered the correct method for obtaining samples. When obtaining samples through dewatering,

proceed with normal procedure at two distinct intervals. Additionally, use the highest level of safety possible when loading large bags onto Shaking tables.

Figure 2.18 – Sample collecting rod

Worked on surface operations, including work at the processing flotation plant and K&B plant. The primary focus was on Sample collecting. There worked on sample collecting, learned dewatering process etc. Learned proper way of getting samples and got randomly through different positions. When getting samples from de-watering, get it normally through 2 different intervals. And also, when loading big bags to shaking table work that in maximum safety. Mainly we worked with commitment, efficiency, safety, and quality. Overall, the week was marked by efficient processing operations, sample checking, Jaw crusher and K&B plant and trommel sample analysis. I worked on the sieve samples which got from K&B plant. Sieve test was done in jaw crushed 1-O/L and 2-O/L particles and observed differences in each category. Sample collecting in de-watering plant was done every day. Overall this week was marked by different processing operations, sample collecting, moisture analysing and sieving.

Figure 2.19 – Sample collecting through belt

This eighteenth week primarily consisted of work at the dispersion plant to produce Graphite based dispersions and for to continue sampling project of K&B plant samples. Significant time was dedicated to sampling projects at the K&B plant, including weighing and sieving graphite samples under different mesh sizes for particle size analysis. Additionally, tasks included the graphite separated from the K&B plant was fed into the Shaking Table and ongoing sampling projects involving the Automated Dewatering Machine in the Flotation plant.

In the nineteenth week, primarily consisted of work on the dispersion plant to produce aqueous aqua powder mixture and for to continue sampling project of K&B plant samples and PH measuring and sample collecting in floatation plant. Significant time was dedicated to sampling projects at the K&B plant, including weighing and sieving graphite samples under different mesh sizes for particle size analysis. Additionally, add last period of the week worked on quality control unit and floatation plant and wrapping of ball mill final products after packing those.

During the twentieth week, this week primarily consisted of work on the dispersion plant to produce aqueous aqua powder mixture and for to continue sampling project of K&B plant samples and Mesh replacements. Significant time was dedicated to sampling projects at the K&B plant. Additional responsibilities included mesh replacement in the K&B plant and participation in a fire extinguisher demonstration.

Figure 2.20 – Mesh replacements

The graphite powder sample was taken into a sample bag from an Automated Dewatering Machine, it was taken to the quality control unit, and then moisture content of the sample was measured using a moisture analyser. Next day, Worked on ball Mill plant with plant

operator. The graphite powder sample was taken into a sample bag from an Automated Dewatering Machine, the sample was taken to the quality control unit, and then moisture content of the sample was measured using a moisture analyser. Next day, filled the Ball Milled Graphite to bags and got samples from those. Worked on particle analysing by Pascal sieve machine and weighted by analytical balance to check whether particles are in correct size.

Fourth day in this week, Worked on Wrapping of Ball Mill products with polythene and by using sharing wrapping gun. Water samples were taken into sample bottles from the Rougher Cell, Rougher Tailing Cell, and Cleaner Cell of the ongoing Flotation plant, the sample bottles were taken away to the quality control unit, and the PH. values of the samples were checked using a PH meter and recorded. Last day in this week, Centrifuge water samples were taken into two sample bottles from the Automated Dewatering Machine in the Flotation Plant, the sample bottles were taken away to the Laboratory, and precipitated graphite samples were taken from each sample bottle, put on sample plates and kept dry on the hot plate after that 10g of the dried samples were weighed using an analytical balance and placed the sample on the ordered meshes as #60, #150, and #200 and put in the Pascal Sieve Machine and sieved for 15 minutes.

Next week worked on mesh replacement in K&B plant with another three people. The graphite powder sample was taken into a sample bag from an Automated Dewatering Machine, the sample was taken to the quality control unit, and then moisture content of the sample was measured using a moisture analyser. The compressive strength of the newly laid concrete was measured using a rebound hammer, and rebound indexes was recorded. Next day, the graphite powder sample was taken into a sample bag from an Automated Dewatering Machine, the sample was taken to the quality control unit, and then moisture content of the sample was measured using a moisture analyser.

The hand-sorted stones, BL 60 - 65, BL 90 - 92, and BL 97 - 99 grades graphite lumps were collected and taken away to the quality control unit and the densities of each grade lumps were measured using buoyancy balance and recorded. Third day, in this week, Worked on mesh replacement in K&B plant with plant with another three people. Then worked on unloading of empty drums to the Dispersion plant. And worked on Refilling of Big bag which is filled with 60-65 Graphite particle which was scheduled to be fed to floatation plant. Next day, I worked at Dispersion plant in the processing section along with a plant operator. And Aquent 441 PTS grade was dispersed in four batches using the dispersion plant according to the factory worksheet and samples were taken into sample bottles and sent to the quality control unit. And after that worked in packing Section with another operator and Blinded straps by laying Cardboard around Package and sealed it after that, Wrapping is done for better finishing and to stop moisture entering to the package. Last day in this week, worked on laser particle analyser with laboratory Head. Firstly, three steps of washing were done in laser particle analyser. Analysed particle size of aqua net grade by dissolving it with water and Detergent, then it was analysed by adding some drops to laser particle analyser.

Figure 2.21 – Laser particle analyzer

The focus included changing the meshes of the K&B plant, Worked on Dispersion plant, worked on packing section preparing for the Rotex plant replacement, where concrete strength checks were meticulously performed. Sampling projects from the Automated Dewatering Machine in the Flotation plant were consistently executed, involving the collection of graphite samples, moisture content measurements, and comprehensive data sheet updates. The Flotation Plant received detailed attention, with sampling activities extending to Rougher, Re-Cleaner, Cleaner, and Scavenger cells. Additional responsibilities comprised working in the hand-sorting area, checking the densities of graphite lumps and studying the Particle Size Analyzer's workings in the quality control unit.

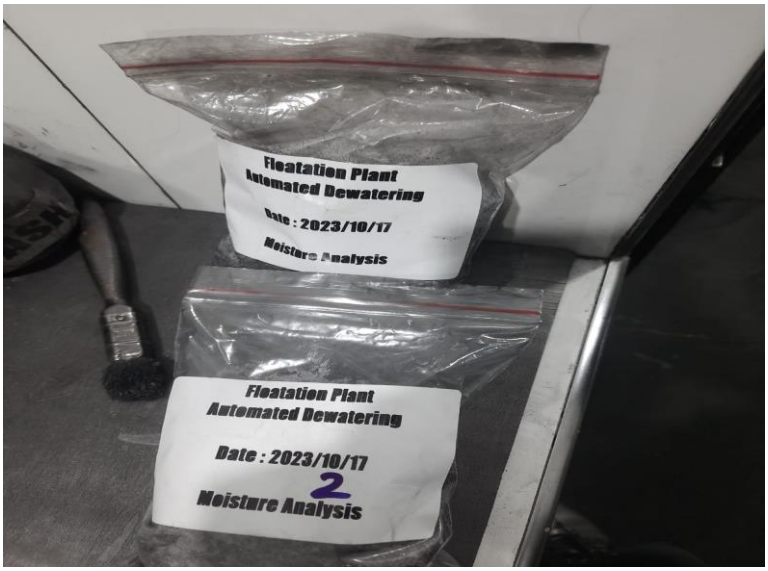


Figure 2.22 – Floatation plant automated dewatering unit samples

Visited Rangala mine and Learned mine's structural orientation and construction and entered through upper adit to the mine and visited two work places. After that learned about 3 veins in mine and location. Second day, worked at the on work place no 4 and helped to work on crosscut which connect middle adit and upper adit. And I engaged in hammering and filling wagons and passed materials via ore passes. Next day, I was assigned to No.03 workplace in the middle adit sublevel, with two other workers to start a new cycle. The front rock of the Drive was drilled and blasted using water gel and ANFO. After that the below adit (Pieris adit) of the Rangala mine were studied with the supervisor. Next day, engaged in loading drums to a container which was filled earlier in a single level, and got some knowledge on loading drums one on another by placing ply wood sheets. Before loading checked whether is there any mistakes done label and counted one by one and checked is there any polythene or unwanted thing attached. I participated in the celebration of completing 2000 consecutive days without any lost time accidents at Bogala Graphite Lanka PLC.

Figure 2.23 – Floatation plant automated dewatering unit samples

I was assigned to the location where the new Shaking Table is being assembled in the processing section by the engineering services section. There, the table surface of the Shaking Table was brought and lifted using a hand chain hoist with gantry. Next day, I was assigned to the laser engraving machine in the electronics room of the engineering services section. And there, I was able to study how to engrave using a laser engraving machine and the computer software used for it was Laser GRBL. Third day, I was assigned to the laser engraving machine in the electronics room of the engineering services section. And there, the names designed using Adobe Illustrator software were engraved on the covers of the company's new diaries using the laser engraving machine. Next day, I was assigned to where the new Shaking Table is being assembled in the processing section by the engineering services section. There, the gearbox Table was placed box support using a hand chain hoist. After that I was assigned to the laser engraving machine in the electronics room of the engineering services section. There, the names designed using Adobe Illustrator software were engraved on the covers of the company's new diaries using the laser engraving machine. My assignments centred on the assembly of the new Shaking Table in the processing section,

led by the engineering services section. This involved tasks such as lifting the table surface using a hand chain hoist, placing it on knife-type horizontal supports, fixing the discharging area, and positioning the head of the Shaking Table. Concurrently, I worked on the laser engraving machine in the electronics room, learning the operation of the machine and the associated software, LaserGRBL. Names designed in Adobe Illustrator were engraved on the covers of the company's new diary

On the first day of the twenty forth week, I was assigned to the engineering services section of the Bogala mine. And I was assigned where the Rotex plant is expected to be replaced in the processing section by the engineering services section. There, the steel members needed to install a gantry for the Rotex plant, were measured and cut using an oxy-acetylene flame. Next day, I was assigned where the Rotex plant is expected to be replaced in the processing section by the engineering services section. There, the cut steel members were fixed to install a gantry for the Rotex plant which is expected to be replaced. And I was trained to weld using an arc welding machine. Next day, I was assigned where the Rotex plant is expected to be replaced in the processing section by the engineering services section. There, the cut steel members were fixed to install a gantry for the Rotex plant which is expected to be replaced. The next day, I was assigned to the laser engraving machine in the electronics room of the engineering services section. And there, the names designed using Adobe Illustrator software were engraved on the covers of the company's new diaries using the laser engraving machine. I worked on the laser engraving machine in the electronics room, mastering the operation of the machine and the associated software, LaserGRBL. Names designed in Adobe Illustrator were engraved on the covers of the company's new diaries. To enhance efficiency, a database was created using Google Sheets for managing the new diaries used in the laser engraving process.

In last week of my industrial training, The Engineering Services Division took over the preparation work instead of repairing the Bogala mine in parallel to working on the floating cell operator and the floor standing drill, I worked on the laser. Carving in electronic room and it, mastering work and related Software, LaserGRBL. Company names designed in Adobe Illustrator engraved on new covers and diary setting.

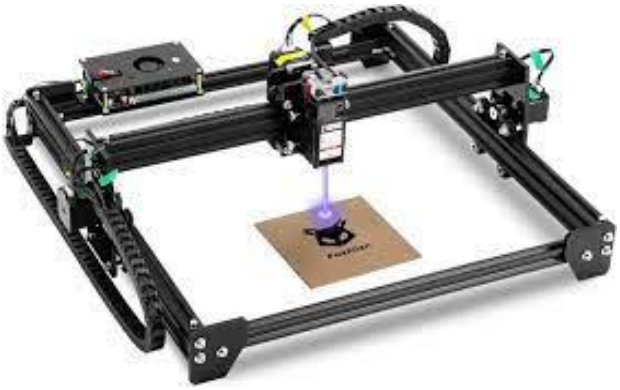


Figure 2.24 – Laser engraving machine

CHAPTER 3 : MANAGEMENT EXPERIENCE GAINED DURING INDUSTRIAL TRAINING

3.1 Safety Introduction

Bogala Graphite Lanka PLC introduced of safety procedure. When visitors or any other individuals come to visit the underground mine, they conduct a safety introduction. They do safety introduction when visitors or any other persons come to visit the underground mine. The main points of safety are,

- Maintaining safety and conducting necessary safety courses.
- It is imperative to wear personal protection equipment (PPE) before venturing underground.
- It is recommended that personal identity tags be put on display on the board prior to accessing the underground area.
- Chemicals ought to be utilized under the supervision of a supervisor and with the relevant instructions.
- Nobody ought to labour when impaired by drugs or alcohol.
- All injuries and near-miss incidents need to be reported right away.
- It is imperative to adhere to safety protocols when entering locations.

As a safety procedure, it is mandatory for to hang their cards when going for underground. In addition, C0 detectors are used to find whether harmful gasses are present or not. Other divisions also follow the safety procedures related to their work. management styles adopted by the authorities to motivate/control the subordinate staff.

Figure 3.01 - Safety Reminder Notices

Figure3.02 - Personal Protective Equipment (PPE)

Figure3.03 – Emergency evacuation plan & Layout of 72FM Level

Figure 3.04 – Emergency Bed to carry patients for surface

3.2 Division meetings, Union meetings, Director meetings

By holding division meetings, union meetings, director meetings, the problems of the staff are discussed with the authorities, and the subordinate staff are controlled and motivated by the authorities by considering their suggestions and providing solutions. Apart from that, giving the staff the benefits and opportunities they deserve, organizing various things to make the staff happy (sport meets, annual trips, get-togethers etc.).