Translated from Arabic

Environmental Impact Assessment

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Global Steel Dust Gulf LLC.

Executive Summary

- Global Steel Dust Gulf LLC Co., (GSDG) has assigned the Arabian Environmental Science Ltd. Company (ARENSCO) to carry out an Environmental Impact Assessment (EIA) study for its Electric Arc Furnace dust (EAFD) recycling plant located in the Dammam second industrial city, in the eastern Province of the Kingdom of Saudi Arabia.
- Global Steel Dust Ltd (GSD) deploys the reliable Waelz Kiln technology that successfully processes over 80% of the world's recycled steel dust. It is a stable, reliable, simple and economical process.
- The process main product (Waelz Zinc Oxide - WZO) is easily salable as zinc oxide is badly needed by the zinc smelters.
- The co-product (Waelz Iron Product- WIP) can be applied for road construction, civil constructions (filling up) or by the cement industry. Research is currently carried out to assess the possibility to increase the WIP added value.
- Through this recycling process, a valuable product is extracted from the hazardous waste (Waelz Zinc Oxide) so valuable resources are kept instead of being damped in landfills and lost.
- The off-gas are processed and purified, thus, the Waelz kiln does not pollute the air. The air discharged from the process conforms to the local, European and American environmental standards.
- This recycling facility will be contributing in protecting the environment by using the most advanced technical methods to recycle a resource currently being landfilled.
- This project has been determined to be a Category 3 EIA project. The EIA was carried out in line with the scope approved by the Presidency of Meteorology & Environment (PME) and as such the purpose of the assessment was to identify in advance the potential environmental impacts from the proposed project and to determine and incorporate suitable mitigation, monitoring and control measures.

Based on the assessment of potential impacts from the construction, commissioning and operation of the proposed project, the findings of this EIA study are summarized as follows:

Air Quality:

The impacts on air quality are expected in the construction phase due to dust and vehicular exhaust emissions and during the operational phase of the plant from the EAF.D handling, loading/unloading, storage of EAF.D & recycling process etc. However, as the construction activities are temporary the impacts are manageable with provision of adequate mitigation and control measures. Mitigation measures are provided in section 7 for dust control. However, the air dispersion modelling results indicate that PME Air Quality Standards are unlikely to be exceeded as a result of emissions from the proposed plant. Thus impact on air quality is not expected to occur during operational phase.

Dust Recycling: Dust recycling is in the rotary kiln furnace of the Waelz system for extracting metals.

Dust recycling not only reduces landfilled waste but also permit the recovery of a zinc oxide product through the recycling processes.

Exhaust Gas is continuously drawn by a closed pipe system and transferred through a settling chamber for large particulate dropout to improve product quality and then to the bag filters where lead, sulfur dioxide, dioxin and other tiny bodies are removed mechanically by a filtering system and collected by the transferring system to be recycled.

A detailed air dispersion study was conducted to evaluate the probable effect of the proposed stack. Air dispersion modeling is carried out by using AERMOD Model. Results indicated that it is improbable that emissions issued by the proposed Plant exceed the limits of air quality issued by the PME.

Because of high calcium content (CaO) in Electric arc furnace (EAF) dust, most of the sulfur in the feeding material is locked up in the solid material in the kiln and becomes a part of Waelz iron product mainly as CaS/ CaSo4 – Fes.

Dioxide reduction process was successfully applied in Waelz Plant to ensure that the fixed dioxin emission shall be reduce to less than 0.1 Nano-gram/m^3 and Teq-(standard – dry).

Soil and Groundwater:

The impacts on soils and groundwater are expected in the construction as well as operation phases. The nature of construction activities and use of equipment and machinery may impact the soil profile in the project areas. However, adherence to appropriate mitigation measures as described in section 7 at project site are expected to minimize impacts to soil and groundwater during the construction and operation phases.

Flora and Fauna:

Cutting down trees, driving animals away from the project area and displace them during the construction phase are not considered significant as vegetation in the proposed project site are insignificant and also there is no presence of any endangered or threatened species. However all the project activities should be regulated to ensure that any negative impacts will be in a limited area, thus it is not expected to have any significant effect on flora and fauna.

Noise:

Noise is expected to occur during the construction and operating phases of the project but observing the appropriate mitigation measures reduces this effect to the minimum as shown in chapter 7.

Health and Safety:

Various health and safety hazards exist in any construction effort. The project CEMP should broadly identify the various hazards and risk minimization and control measures including the use of PPE, medical surveillance, regular interval audits and reviews. Typical hazards for which controls must be implemented include but not necessarily limited to physical hazards, chemical hazards, biological hazards and other hazards.

This EIA has concluded that significant environmental impacts occurring during the construction and operation phases of the project that can be mitigated and controlled by implementing various mitigation measures proposed for all identified significant effects and recommendations provided in this report.

Recommendations:

- A hazardous and non- hazardous wastes management plan (WMP) and health is required during the construction and operation phase of the proposed project as stated in the eighth chapter (8) of this report.

- A manager of health, safety and environment (HSE) should be appointed to be responsible for training of the GSDG's staff members about general environmental issues as well as specific protection measure at the plant location.

- With proper adoption of Environmental Management Plan established by EIA report, the overall environmental performance is in the compliance with PME regulations. GSDG should commit to continuously improve its plant operations and environmental performance in line with prevailing environmental legislation.

- A comprehensive emergency response plans should be developed by GSD Gulf Ltd. for use in the event of a fire, major leak, or other serious incident occurring at or near the proposed facilities. The plans are designed to prepare employees and local emergency response personnel to handle emergencies involving facilities and protect the public. Communication and cooperation with local organizations are key components of the emergency response plans, and the feedback from these interactions is used in the development and revision of these plans.

Observation of the Presidency of Meteorology and Environmental Protection

	Observation	Reply	Location
1	Impacts resulting from transfer and delivery of raw material	Dust will be transferred to the factory by closed trucks. There will be no emission as they will be loaded and unloaded mechanically by pneumatic means.	From 3.14 till 3.22
2	Different emissions resulting from the industrial processes	All expected emissions during the construction and operation process are considered in the chapter seven, besides control process of these emissions.	From 7.12 Till 7.27
3	Professional safety for staff members in all production phases, particularly noise	Scientific strict standards will be applied in the company factories all over the world. This is described in chapter 10.	From 10.1 Till 10.26

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1. INTRODUCTION

1.1 Arabian Environmental Science Ltd. Company (Arensco) prepared this Environmental Impact Assessment report for Global Steel Dust Gulf Co., project (GSDG). This project relates to the construction and operation of Electric Arc Furnace Dust (EAF.D) Recycling Plant which will be located in the Second Industrial City, Dammam, Eastern Province in the Kingdom of Saudi Arabia.

1.2 The environmental impact assessment report will be presented to the Presidency of Meteorology and Environmental Protection (PME) to get the required approval.

1.3 Global Steel Dust Ltd (GSD) is a privately owned company focused on the recycling of hazardous Electric Arc Furnace (EAF) dust using the latest Waelz Kiln technology.

1.4 GSD was created to capitalize on the lack of EAF dust recycling facilities globally. It is estimated that out of 6 million tons of EAF dust generated yearly in the world, only 2.5 million tons is recycled, mainly in the United States, Europe, Taiwan and Japan.

1.5 GSD has signed a memorandum of understanding with a Saudi company to build a steel dust recycling plant in the Kingdom of Saudi Arabia with the name of Global Steel Dust Gulf Co.

1.6 Through the recycling process, a valuable zinc product is extracted from the hazardous waste, thus recovering precious resources that otherwise end up in landfills

1.7 By combining its proven track record and technology, GSD believes it provides the best solution to the steel industry's growing hazardous waste problem.

1.8 Global Steel Dust Gulf Ltd. (GSDG) leverages the most reliable process technology to safely and cost effectively recycles the hazardous waste produced during steel production from Electric Arc Furnaces (EAF).

1.9 By combining its proven track record with the proven Waelz Kiln technology, GSD provides the steel industry the solution to their hazardous waste problem by recycling their steel dust safely, reliably and with environmentally sound practices.

1.10 Global Steel Dust (GSD) deploys the reliable Waelz Kiln technology that successfully processes over 80% of the world's recycled steel dust. The Waelz Kiln process is an established, energy-efficient and resilient technology used to treat zinc containing materials and residues.

1.11 Although Waelz technology has been around for over 80 years, the design and technology surrounding the basic kiln has improved throughout this time. In fact, we believe that GSD has advanced the design further than any company and now has what is considered to be the best-designed system anywhere in the world.

1.12 As a result, this continually improving process continues to be the industry's Best Available Technique (EU BREF notes) and Best Demonstrated Available Technology (US – EPA) for recycling high zinc content EAF dust and other zinc bearing waste.

1.13 Energy efficient and clean, the Waelz Kiln technology is especially suited to the increasing demands of environmental laws being implemented globally.

Environmental Impact Assessment Category

1.14 As per the PME Environmental Regulations and General Environmental Law and Rules for Implementation the GSD's Electric Arc Furnace Dust recycle proposed plant is classified as a Category 3 EIA project.

1.15 The EIA was carried out in line with the scope approved by the Presidency of Meteorology and Environment so that they are fully compliant with the applicable PME general environmental regulations and guidelines.

Report Structure

1.16 after the introduction the report is organized as follows:

- Policies, laws and regulations (chapter 2)
- Project description (chapter 3)
- Needs for and scope of assessment (chapter 4)
- Baseline conditions (chapter 5)
- Air Dispersion Modelling Study (chapter 6)
- The environmental impact and mitigation (chapter 7)
- Waste management plan (chapter 8)
- Environmental management plan (chapter 9)
- Health, safety and environment (chapter 10)
- The required training (chapter 11)
- Conclusions and recommendations (chapter 12)

Objective of the study

1.17 The general objective of studying the environmental impact assessment is to provide information about the nature and size of the probable environmental impacts resulting from the proposed project to recommend the appropriate mitigation measures to control the probable environmental impacts in a way that conforms with the Presidency of Meteorology and Environmental Protection (PME) requirements and to confirm the environmental acceptability of the project.

1.18 The general procedure of assessment includes description of the baseline environmental conditions, identification and evaluation of potential impacts and recommendations for mitigation measures and an environmental monitoring program. The assessments in this EIA Study are conducted using well proven national and international accepted methods.

2. POLITICAL, LEGAL AND ADMINISTRATIVE ASPECTS

National Aspects

Presidency of Meteorology and Environmental Protection

2.1. The principle National Environmental Regulatory body within Saudi Arabia is the Presidency for Meteorology and Environment (PME). The Public Environmental Law was enacted by Royal Decree No. M/34 on the 16th October 2001, and was published in the Official Gazette number 3868 dated 9th November 2001. The Public Environmental Law created a general regulatory framework for the development and enforcement of environmental rules and regulations, and assigns general responsibility for this to the Presidency of Meteorology and Environmental Protection.

2.2. The Implementation Regulation to the Public Environmental Law was issued by the Minister of Defense and Aviation Resolution No. 1/1/4/5/1/924 dated 30th September 2003 (the "Implementing Regulations") and published in the Official Gazette No. 3964 on 25th October 2003). The Implementing Regulations came into force on the date of publication. These are generally referred to as the General Environmental Regulations and Rules for Implementation (GER).In addition to its responsibilities under the Public Environmental Law, the PME is made responsible for issuing or withholding its consent for projects so as to ensure compliance with the Public Environmental Law and the Implementing Regulations.

2.3. The Kingdom of Saudi Arabia’s environmental standards are set by the PME in coordination with the concerned agencies. Articles 4 and 5 of the GER require the Public and Licensing Agencies to implement the GER and its implementing laws on companies and projects under their jurisdiction. Consequently, this EIA report which relates to the GSD Gulf Ltd. facility should therefore be sent to the Presidency of Meteorology and Environment (PME) for acquiring the necessary approval.

International Aspects

2.4. Saudi Arabia has ratified or is a signatory to a number of international agreements and conventions. Of possible significance to the review will be the United Nations Industrial Development Organization (UNIDO) service modules with the common aim of ensuring sustainability, which include (but not limited) to the institutional strengthening for the preparation of regulations, codes of good production and maintenance practices, environmental protection, and occupational health and work place safety.

2.5. This is consistent with UNIDO's goal to strengthen the legal and regulatory framework for conformity as well as assisting developing countries in providing an enabling environment for the growth of the private sector industries.

2.6. The agencies concerned in the Kingdom also support regional and international conventions for the protection of the environment, and participate with the international community in this respect.

Agenda 21

2.7. The Kingdom of Saudi Arabia adopted Agenda 21 of the United Nations Division for Sustainable Development and its policies on the environment and development based on principles of Islam which have ordained people to thrive and inhabit the earth as the primary function of humankind. Accordingly, utilization of the natural and environmental resources of the Kingdom has been ascertained with the purpose of satisfying requirements without tampering with the capabilities and rights of future generations.

2.8. In this respect the kingdom approved the principle of preventive measures, hence, the principle of environmental impact assessment within feasibility studies of proposed projects was adopted.

2.9. The agencies concerned in the Kingdom also support regional and international conventions for the protection of the environment, and participate with the international community in this respect including application of such conventions and financial contribution

3. PROJECT DESCRIPTION

Project justifications

3.1. Production of steel in Electric arc furnace (EAF) generates a by-product known as EAF steel dust. These steelmaking flue dusts are classified in most industrialized countries as hazardous residues (according to the US EPA classification, 1980) because the heavy metals contained in them, tend to leach under slightly acidic rainfall conditions.

3.2. Being considering as hazardous wastes in most of the industrialized countries, these residues must be stored in specialized landfills.

3.3. These considerations led to recycling this dust, thus reducing its environmental impact. Meanwhile, it contains zinc which can be used as a source to get valuable products.

3.4. Waelz kiln technology is one of the most applied pyro-metallurgical process for the recycling of dusty steel mill residues world-wide, especially for EAF dust

3.5. Main reasons for using the Waelz Process:

- It is established, stable process
- It is a robust and reliable process
- It is a simple well known metallurgical process
- It is an economic process
- The process products can be sold (zinc oxide is welcome by all zinc smelters)
- Waelz Iron Product can be used directly in road construction, civil constructions and cement industry. or can be reprocessed to add more value to the iron content which is currently under research and development;
- Sponge iron can be recycled in Electric arc furnace
- extended range of treatable feed material by process modifications
- Modern development is less than 200kilo from coke or coal for every ton of steel dust feed
- Waelz kiln technology that successfully processes over 80% of the world's recycled steel dust
- The recycling process is designed in a way to be efficient in using power and flexible to treat zinc containing materials and residues, consequently achieve good returns on investment
- Through the recycling process, a valuable zinc product is extracted from the hazardous wastes, consequently valuable resources are regained instead of throwing them in landfills
- The dust free off-gas are treated and purified, consequently Waelz kiln does not cause air pollution

- The air released from the process conform with the standards of the American, European and local environment
- Contribution to environment protection by applying the most modern methods of technology

Project location

3.6. Global Steel Dust Gulf Co., (GSDG) intends to build a Plant for recycling the dust resulting from Electric arc furnace in the second industrial city in Dammam – the eastern area of the Saudi Arab Kingdom.

Figure 3.1 indicates the location of GSD – Gulf

3.7. The proposed project is situated near the latitude N “25.98” 16 26 and the longitude 16.35 57 49 in the second industrial city in Dammam. The figure 3.2 shows the satellite photos for the situation GSD Gulf limited.

Figure 3.2: Satellite Image for the location of the Proposed Project of GSD

3.8. A site assessment was conducted on 26 of September and 13 of October 2012 in order to identify, the extent feasible, environmental conditions with regards to the location of the proposed project. The subject property is undeveloped flat, vacant and empty land without vegetation as well as rubbles and stone debris etc. were also noticed on project site during site visit (Figure 3.3).

3.9. The total area of the proposed Plant amount 48976 and land dimensions are 288meter (length) and 170 (width).

Figure 3.3: Site visit pictures

Waelz kiln Technology

A general View

3.10. The pyro-metallurgical treatment of Zn bearing residues like filter cakes from Zinc smelters or steel mill dust, especially EAF.D, is a well-known technology, which uses a rotary kiln as key equipment. Its origin dates about 100 years ago where it was first applied for the enrichment of low grade Zinc ores. In the recent years this technology, also known as Waelz process has been improved in terms of energy (coke) consumption and of emission control of hazardous substances. The Waelz process fulfills the requirements of the Best Available Technology for environmental protection. It is notified in the BREF notes of the European Community (Non-ferrous Industry, December 2001)

3.11. The Waelz process as described in below Figure 3.4, 3.5, & 3.6 is quite robust and can deal with a wide range of feed materials. It is most applied in the world (about 80 %) for EAF.D treatment. Though the standard application is dedicated to one major kind of Zn bearing material, also the combined treatment is sometimes used. For the co-treatment the process can be easily adopted under the condition that the raw material preparation should be executed properly for a stable and homogeneous feed generation.

Figure 3.4 The Flow chart of the EAF dust recycling plant

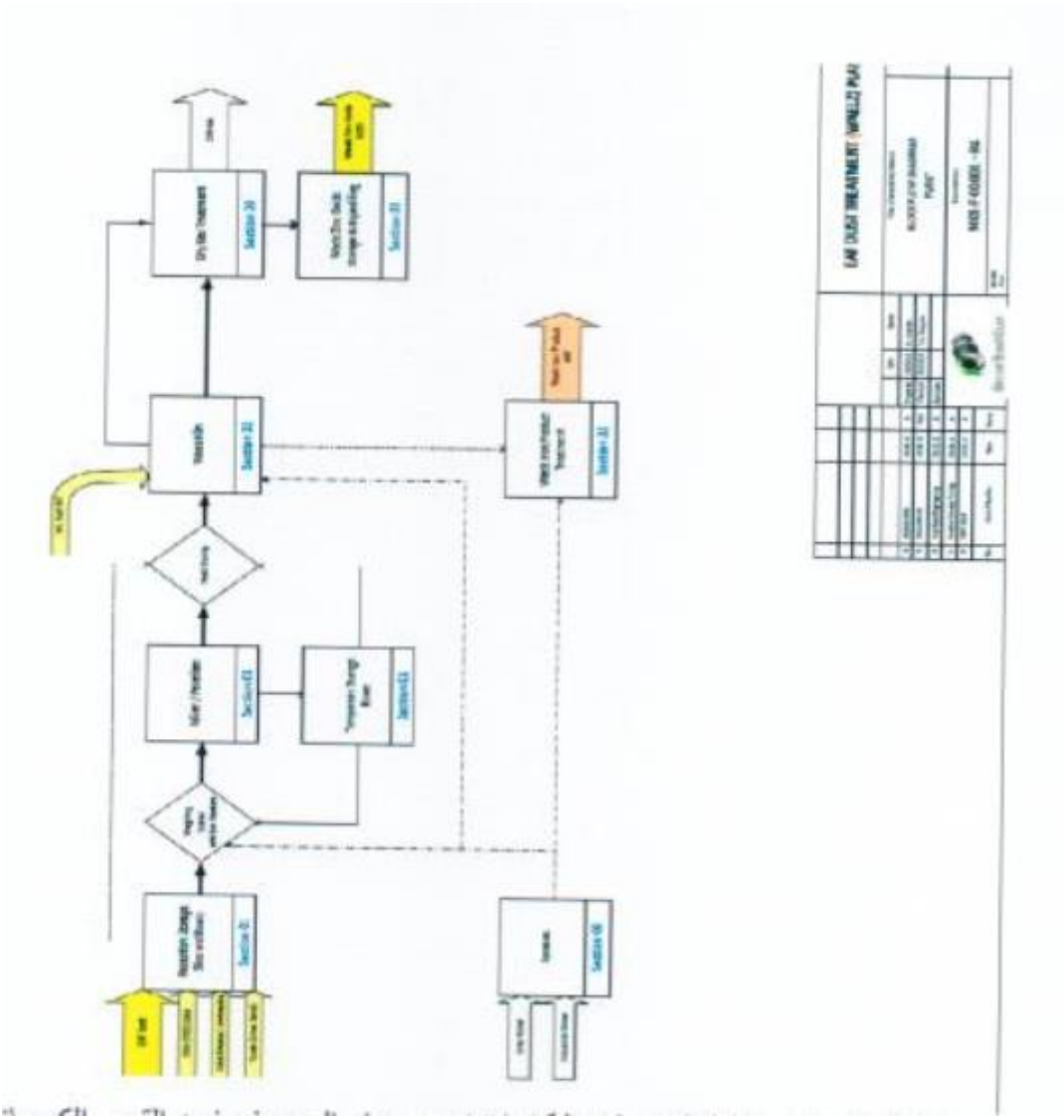
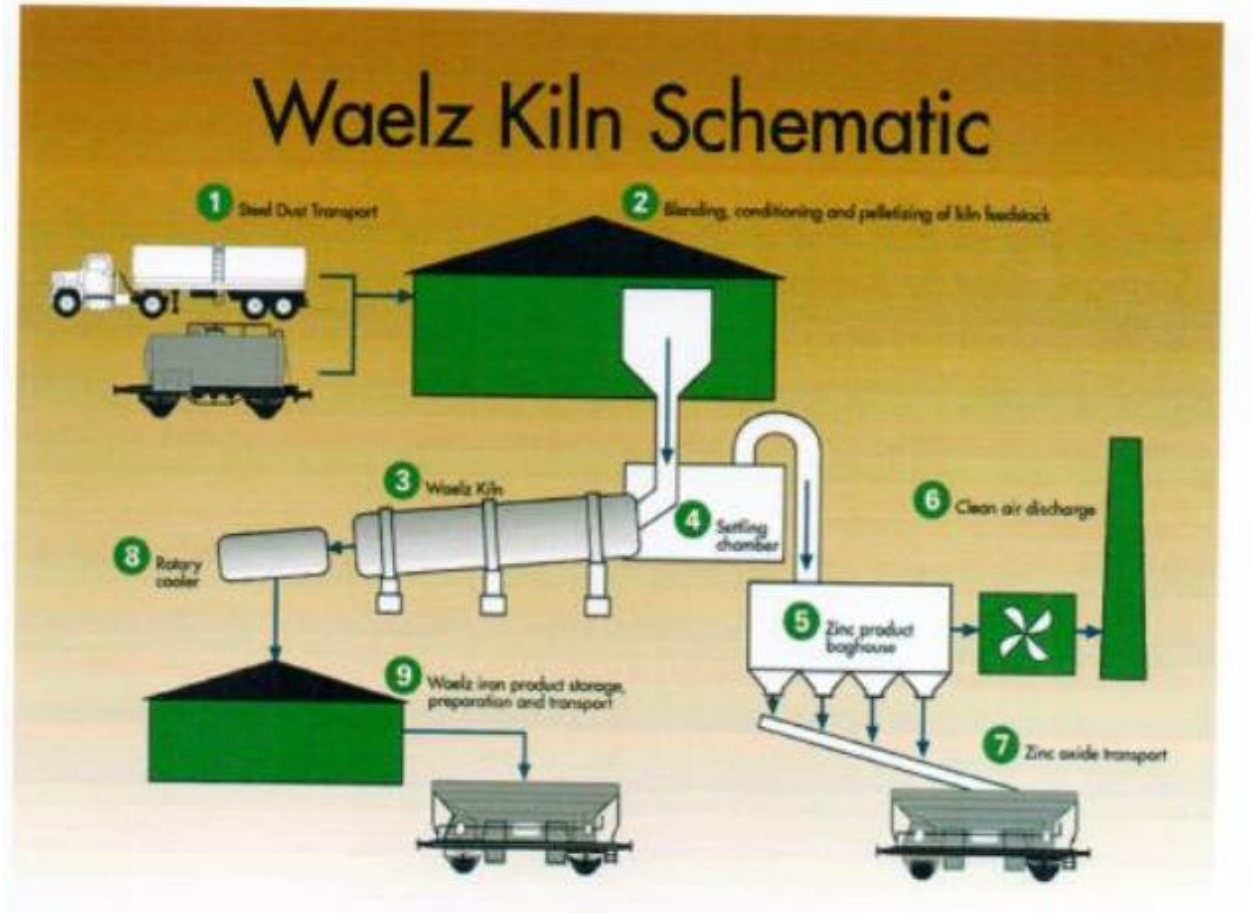
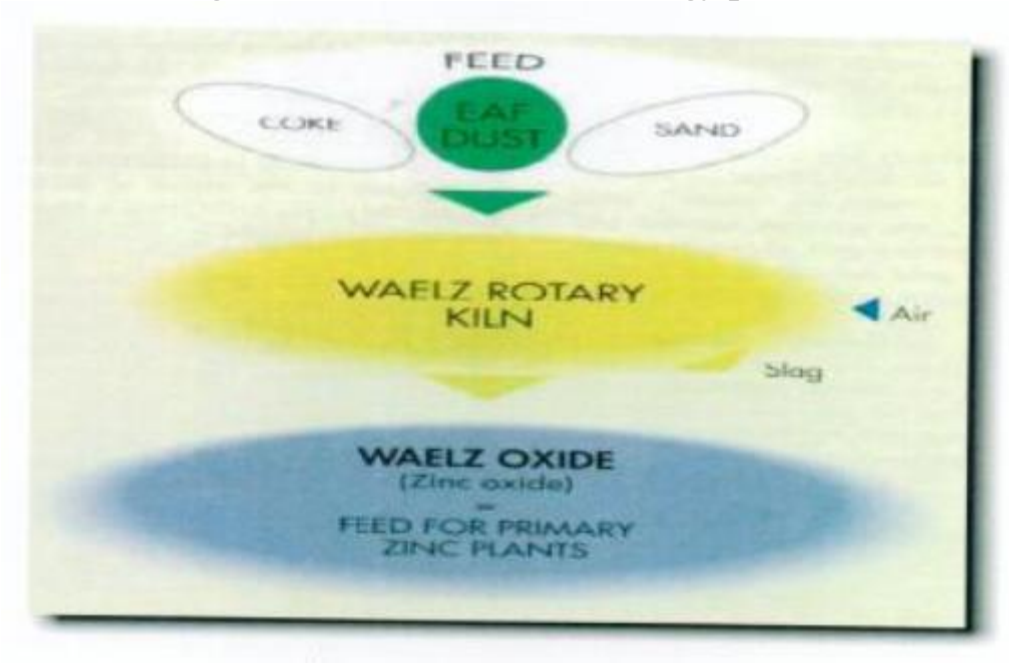


Figure 3.5: Waelz Kiln Technology Schematic



الشكل 3.5: الرسم التخطيطي لتكنولوجيا فرن ويلز

Figure 3.6 Waelz Kiln Technology process



Process Description

3.12. divides the whole project according to Waelz Plant methodology available in the following departments:

Section 1 : raw material preparation

Section 2 : Waelz line

Section 3 : Gas treatment

Section 8 : Annexes

3.13. Above Figure 3.4 represents Block Flow Diagram, which gives an overview of Waelz Kiln.

Transport and Raw material Preparation:

3.14. This section is dedicated to the handling of the solid raw and intermediate materials of the process, i.e. receiving, storing and mixing.

3.15. The main raw material in steel dust which is taken from many steel mills as a dry powder in trucks. It could be received partially intermediate bulk containers (IBC). Another part of steel dust could by obtained by transferring the old material which is stored in the steel mills to GSD company with covered tip trucks.

3.16. The reduction agent used is coal which is mad available as coal breeze (0 to 16mm) or as wet fine coke (0 to 4mm) or as dry coke fines (<2mm.). Anthracite coal can also be used mixed with coal breeze to feed the kiln directly. The slag is formed from limestone (dry <1mm.) to compensate the low basicity or sand (moist,< 4mm.) to compensate the very high basicity of this mixture of raw material.

3.17. Raw material delivery is done by two different methods: the moist and the coarse material such as agglomerated EAFD, sand, coke breeze and wet coke fines (brought in tip trucks) is unloaded and stored in separate boxes inside the mixer unit (a box A9100 for Electric arc furnace dust: B1170, for sand B1150, for coke breeze B1130, for wet coke fines B1160. The dry and fine (dusty) material such as Electric arc furnace dust, dry coke and lime (brought in trucks) is discharged and stored in several silos (4 silos for EAF.D: B1010 to 1040, for coke fines/PET coke: B1050, for lime: B1060). The discharge of the silo trucks is made by diluted phase pneumatic transport into the dedicated silo. EAF.D in IBC is also send to 2 of the silos (B1010 and B1020) by pneumatic conveying via the sender H1840 after being screened (F1810) for separating lumpy agglomerates.

3.18. The main function of this section is the preparation of a uniform and stable feed for the Waelz kiln, especially for the different zinc containing materials. In order to achieve this target a special batch type mixer (so-called intensive mixer; R1300) is used. It mixes the different kind of dry EAF.D with dry or wet coke fines, bulk EAF.D, EAF.D pellets and lime according to specified prescriptions. The purpose of the intensive mixer is a double one: homogeneous mixture of all different components and formation of micro-pellets of 0 to 10 mm (95 % > 0.5 mm, 5% > 4 mm).

3.19. The dusty materials are fed to the mixer by gravity and screw feeders (H1211 to 1216), passing a weighing hopper scale (X1220). The coarse materials are fed to the mixer by weighed box feeders (X1241/X1242) and belt conveyor (H1250). A certain amount of water is added to the mixture in order to form agglomerates. The correct dosing of water is done in a loss-in-weight scale (X1230). The agglomerates produced in the mixer are called self reducing pellets (SRP), because they contain sufficient reduction agent. For easier handling of the SRP a small amount of dry EAF.D is added to the mixer via a loss in weight feeder (X1225/H1226) at the end of a mixing batch.

3.20. From the discharge of the mixer (B1310/H1410) the SRPs are transported into the weighed box feeder for the kiln feed dosing (X1521) by belt conveyor (H1420). As alternative way the discharge to a small box (B1100 via Y chute X1430) is foreseen if the kiln cannot take the total amount of produced SRP temporarily. For temporary storage pay loader take the SRP to 3 storage boxes (B1111 to 1113). All boxes and the box feeder are installed in the “mixing plant building” (A9100).

3.21. Especially for bridging the annual maintenance standstill of the rotary kiln, which might last between 2 and 4 weeks, an additional storage space in 3 boxes (B1121 to 1123, inside A9100) is foreseen. . When Waelz kiln is stopped, steel dust will be fed only without any reduction factors or lime with water to the mixer (R1300) to reduce the amount of the contemporary stored material. The stored pellets will be gradually re-fed to the mixer through the feeder (x1241) in addition to freshly received materials hence the standstill is over.. The pellets additional running through the mixer is necessary because of the partial degradation of the pellets which will be stored for longer period. A high rate of fine material and dust in Waelz feeding system leads to a state of poor quality product

3.22. The mixing plant building (A9100) is a closed building, which is kept under negative pressure by an exhausting system consisting mainly of a bag house filter (F1910) and a fan (V1920). Also some units of the mixing tower are connected to the exhausting system. The recovered dust is send via an IBC, the bulk EAF.D box (B1170) and the box feeder (X1241) to the mixer (R1300). The doors to the building (A9100) are normally kept closed. They are opened only for a short time for entering or leaving of the silo trucks supplying raw materials.

Feed dosing:

3.23. The solid material feed for the Waelz kiln is composed of SRP (Self Reducing Pellets) and coke breeze in general. For the eventual re adjustment of the slag's basicity sand addition in small quantities is foreseen. For all components weighed box feeders (SRP: X1521/22, coke: X1523, sand: X1524) in combination with weighing belts (H1551/52) are installed. The hoppers of the feeders are filled regularly, X1521 by belt directly from the mixer, the other by pay loaders. So, each component is dosed onto the long, inclined feeding belt (H1560), which discharges the feeding material to the kiln feeding pipe (X2001). For a stable operation of the Waelz process the accurate dosing of the materials is indispensable, especially the SRP coke

ratio is important. The feeding belt (H1560) is installed inside the closed mixing plant building (A9100) and then for bridging the space between the building and the feeding room above the DSC (F2200) inside a closed tube.

Waelz Line: Waelz kiln

3.24. Solid material will be transferred inside Waelz kiln (D2000) from the end of the feeding to the end of unloading by operating the drying kiln (about 8turn/minute and slope of 2.5%. First the SRP is dried and heated. Then different reactions will occur during material transfer. During processing, all zinc and non ironic metals and salts will evaporate. Most of iron oxide will be reduced thus the cargo change into the slag.

3.25. In addition to process air, the secondary air will be drawn from the kiln to the kiln head (A2100) thus, collect the hot cooling air from the cooling kiln (w2600). Air combines with the carbon in the charge to produce CO gas which reduces the zinc oxide in the charge to zinc metal vapor which is reoxidized above the charge.

3.26. The flow of air in counter current to the flow of the charge in the kiln and the reoxidized zinc is transferred by the gas flow through the settling chamber to the bag collector.

3.27. The movable burner (D2110; industrial fuel-oil) is mainly used for the cold start up of the kiln after the annual maintenance standstill. During normal operation it is only temporarily used for eventual heating up of the slag for achieving an easier outlet flow from the kiln.

3.28. The bearings of the Waelz kiln (D2000) and also of the Cooling Drum (W2600) are of plain type. For avoiding wear these bearings must be cooled, which is realized by two cooling water cycles using the circulation pumps P2405 for the Waelz kiln and P2407 for the cooling drum. 1 pump (P2406) is installed as stand by unit for the 2 operating. The cooling water is cooled by a cooling tower (W2400) the loss of water by evaporation is compensated continuously in the buffer tank (B2403) by addition of clean industrial water.

Waelz Line: Cooling the WIP (slag)

3.29. For cooling and granulation the hot Waelz Iron Product (WIP, slag) from the kiln outlet falls by gravity via a refractory lined transfer chute (A2105) into the rotary cooling drum (W2600). The cooling takes place by means of heat exchange to the cooling air and radiation / convection of the drum with the ambient. For avoiding over heating of the feeding side of the drum, a water injection system (X2690) is installed as back up.

Waelz Line: Dust Settling Chamber

3.30. In order to increase the zinc content in the product a dust settling chamber (DSC, F2200) is installed directly upstream of the Waelz kiln (upstream in the sense of gas flow). In the DSC the coarse dust is settled and separated from the flue gas, which carries the fine product dust. The coarse dust contains more inert components like FeO, CaO, SiO2 and C than ZnO. This separated coarse carry over is fed back to the Raw Material Preparation for re-processing by a pneumatic conveying system (H2230, V2271, X2238 to B1030/40). Depending on the operating conditions a part of the settled carry-over and the added dust from the mixing cyclone (F3100) might contain already a quite high Zn content. Then this fraction can be send into the product filter (F3200) by another pneumatic conveying system (H2280, V2275 and X2288).

3.31. The DSC serves not only for the separation of carryover but also as the first cooling stage of the kiln flue gas. The flue-gas enters the DSC from the kiln at a temperature in the range of 750 to 850°C. For the cooling purpose fine water spray is injected, which is generated in special nozzles with the aid of compressed air (X2260). The compressed air ensures that the water is distributed as very fine droplets, which are totally evaporated. The injected water is distributed by pumps (P2241/42/43, 1 stand by), which take the industrial water out of a template tank (B2240). The water tank is kept full by continuous feeding of cooling water effluent (from lube oil system A2410); the water overflow is send back to the industrial water storage tank (section 8).

3.32. By a small fan (V2210) sealing air is blown into the feeding pipe (X2001) in order to avoid the uncontrolled emission of hot kiln flue gas in case of interruption of the feeding (chimney effect).. The displaced air is withdrawn from the small fan (V2213)

Waelz Line: Gas treatment:

3.33. The dust containing flue gas leaves the DSC at about 540 to 570°C, depending on the amount of injected water. The further cooling down to about 150°C is done by mixing with ambient air in a mixing cyclone (F3100). This guarantees a rapid cooling in order to avoid the re formation of dioxin and a homogeneous temperature deviation in the flue gas. The ambient air is blown into the mixing cyclone by a speed controlled fan (V3110). Due to the change of flow direction a further fraction of dust is separated in the mixing cyclone, which is send to the chain conveyor underneath the DSC (H2220).

3.34. The product Waelz Zinc oxide (WZO) is then finally separated from the flue gas in a bag house filter (F3200). The WZO is collected by the extractors (H3231 to 3234) in a buffer bin (B3270) and pneumatically transported to 2 storage silos (B3810/20). From each storage silo either silo trucks can be filled (via feeding bellows X3845/46 to avoid defuse emission) or big bags can be packed (weight controlled by balances X3851/52). The silo truck filling is optional in case a local consumer of WZO is available. The big-bags are temporarily stored in a warehouse building (9400) before send to customers as gross bulk or in 20 feet container. The silo trucks carrying about 25 tons of WZO go directly to the client.

3.35. The de-dusted flue gas from the production filter (F3200) is then again mixed with adsorption agent (mixture of lignite activated coke with WZO) in a special reactor (A3400) and filtered in a second bag house (F3410). The separated solid material is re used in the internal cycle (F3410 – H3460 – B3470 – H3480 – A3400 – F3410) several times. A small part is injected upstream of the production filter (F3200) for the first step dioxin adsorption. This is taken by a skimming screw (H3490) out of the internal cycle and dosed by a loss in weight device (X3550) to a pneumatic conveying system (V3560). Fresh lignite activated coke is added together with some WZO to the conditioning rotor (A3400) by another pneumatic conveying system (X3350 / V3360).

3.36. Two parallel fans (V3610/20) send the cleaned off gas from the second bag house filter via the stack (A3700) to the ambient. Two fans (V3610 and V3620) in parallel are used for better operation security. Their motors are connected to an emergency generator (Y8900), which starts automatically if the supply of electricity is interrupted. Thus, for the controlled shut down of the process, a sufficient flow of gas is guaranteed through the Waelz kiln (D2000) and the gas treatment system in correct direction in order to avoid that reaction gas or flames exit the kiln on the kiln head side and that product is released to the atmosphere in uncontrolled manner.

Annexes

3.37. In this section the generation, storage and distribution of liquid and gaseous utilities is gathered.

Compressed Air

3.38. Compressed air is required for the cleaning of the bag house filter (pulse jet air, 6 bars, dew point ≤ 3°C), for pneumatic transport (blowing air, 2 bars, dew-point ≤ 10°C), for the 2 phase water injection nozzles and general purposes (compressed air, 7 bars, dew point ≤10°C). For pneumatic cylinders, knockers etc. instrument air is required for which the pulse jet air quality can be used due to the high ambient temperature. 3 sets of compressors (V8001..3, each 25 m3/min) are foreseen which are equipped with oil filters (F8021..3) and refrigerator driers (T8051..3). The compressed air is buffered in 2 tanks (B8101/02) before it is distributed to the several consumers. For the pulse jet air an additional refrigerator drier (T8131, stand by unit T8132) will be installed. The blowing air is generated by pressure reduction (A8160), which is installed on the ground floor of the mixer tower (A9110) close to the consumers. Here an additional buffer tank (B8150) is used.

3.39. Table 3.1 below describes summary of the chemical reactions in Waelz drying kiln.

Table 3.1: Summary of the chemical Reactions that occur in the kiln

Section 1 **15%**	Charge: H_2O (l) → H_2O (g) $CaSO_4*H_2O$ → $CaSO_4 + H_2O$ (g) $Ca(OH)_2$ → CaO + H_2O (g) Freeboard: no reaction	Freeboard [°C] **720-1000**	**Temperature** Charge [°C] **20-150**
Section 2 **10%**	Charge and Freeboard: C + ½ O2 → CO CO + ½ O2 → CO2 CxHyOz + nO_2 → aCO + bCO_2 + y/2H_2O	**900- 1100**	**150-500**
Section 3 **15%**	Charge: $CaCO_3$ → CaO + CO_2 CdO + CO → Cd (g) + CO_2 CuO + CO → Cu + CO_2 Fe_2O_3 + CO → 2FeO + CO_2 Fe_3O_4 + CO → 3FeO + CO_2 C + CO_2 → 2CO Freeboard: CO + ½ O2 → CO2	**1100-1300**	**500-900**
Section 4 **50%**	Charge: ZnO + CO → Zn (g) + CO_2 FeO + CO → Fe + CO_2 C + CO_2 → 2CO ZnS + Cu → Zn (g) + CuS (Side-reaction) ZnS + Fe → Zn (g) + FeS FeS + Pb → Fe + PbS (g) Fe_3O_4*ZnO + CO → 3FeO + ZnO + CO_2 ZnO*SiO_2 + CO → Zn (g) + SiO_2 + CO_2 Freeboard: Zn (g) + ½ O2 → ZnO CO + ½ O2 → CO2	**1300 (1400)-1000**	**900-1200 (1300)**
Section 5 **10%**	Charge: Fe + ½ O_2 → FeO Burner: CH_4 + 2O_2 → CO_2 + 2 H_2O	**1000-20**	**11500-1000**

Diesel Fuel

3.40. Diesel fuel will be used for the pay loaders, forklifts, maintenance pick-up etc. A small storage tank (B8250) would be installed at the facility premises for the distribution of the diesel to the onsite vehicles.

Industrial Fuel Oil

3.41. Industrial fuel oil is used for the start up burner of the Waelz kiln (D2110) and the emergency generator (Y8900). While the later has an integrated 8 hours tank, a buffer tank (B8260) for the burner is installed onsite in an impermeable concrete catch basin which also houses the diesel tank B8250). When the burner (D2110) is used an oil pump (P8271, stand-by: P8272) supplies the required combustible.

Industrial Water:

3.42. The Waelz Kiln process does not generate any wastewater, but it consumes industrial water for the production of SRP in the mixer (section 01, R1300) and for cooling purposes by means of evaporation at 3 different places (section 02): water injection in DSC (X2260), eventual water injection in cooling drum (X2690) and evaporation losses of cooling tower (W2400). The industrial water is stored in the process water tank (B8615), which has a storage capacity for at least 5 days of consumption. The process water tank is filled by the pump (P8605, stand-by: P8606) out of the template tank (B8601), which is fed by supplied industrial water (in the beginning of the operation by tanker trucks), the water overflow from tank (B2240) and internal grey water. Internal grey water is the effluent from the employee's showers and from the internal washing machines for the workers uniforms. The industrial water is distributed to the process consumers by a pipeline system and the pump (P8621, stand-by: P8622).

Drinking Water

3.43. Drinking or potable water for the employees is stored in 2 tanks (B8701/02) inside the shared services building (A9200) and distributed by pumps (P8721, stand-by: P8722) and a separate piping. The effluent water from toilets is collected in a sewage tank for external disposal

EAF.D deliveries to Recycling Plant

3.44. EAF.D will be received from customers primarily in Pressure Differential Trucks (as described above). These trucks will be loaded from silos at the customer's plants into hatches on the top of the trucks and then pneumatically unloaded into silos at the GSD plant as can be seen in Figure 3.7 below. This mitigates the risk that EAF.D can escape into the environment. As a further protective measure, the steel lines used to transport the dust will be, as far as is practical, routed inside a building to protect the environment should a leak occur in the transport lines. The silos themselves will be housed inside of a building which will be kept under negative pressure to insure no dust can escape into the environment. Some EAF.D will be received in super sacks when necessary to service customers with stored material or without facilities to load Pressure Differential Trucks. The bags will be unloaded inside our receiving building which is enclosed and which is kept under negative pressure by a large fugitive bag collector.

Figure 3.7 Transfer of EAF.D from Silo Truck to the Plant Silo for storage

(Ref: Picture from one of the Waelz kiln operating plant in USA)

Plant Operation and Maintenance

3.45. Plant is designed for fully continuous operation, 24 hours per day, and 7 days a week (24/7). The process layout is done for an annual treatment of 100’000 DMT of EAF.D. The facility can receive the EAF.D in silo trucks or in intermediate bulk containers (IBC) all days of the year.

3.46. For the Waelz kiln (D2000) one annual maintenance standstill for refractory re lining (duration of 2-3 weeks) is required. During this time also the other equipment of the process line in section 02 and 03 are inspected and maintained. While the Waelz kiln is stopped the received EAF.D is only mixed with water for hydration and the generated pellets are temporarily stored in dedicated boxes of the mixing plant building (A9100). This operation is less time consuming, which give the opportunity of maintaining also the equipment of section 01 and 08. The temporarily stored pellets are re-processed in the mixer (R1300) and consumed in the kiln (D2000) in the months following the standstill.

3.47. Aside of fresh generated EAF.D the facility will also treat EAF.D, which is already stored on the sites of the EAF steel mills. This treatment of “old” EAF.D will be only interrupted during the annual maintenance standstill and the few following months until the onsite stored pellets are consumed.

3.48. The Waelz process requires reducing agent with a sufficient content of fixed carbon (Cfix). Two different qualities are used: fine or PET coke to be mixed with the EAF.D in the mixer (R1300) for the generation of SRP (self reducing pellet) and coarse metallurgical coke breeze or anthracite coal for the direct feeding to the Waelz kiln. The coarse materials are shipped in lots of 500 to 800 tons to the facility and are stored in a dedicated box (B1130, 1400 m3) inside the mixing plant building (A9100).

3.49. The same is foreseen for wet fine coke (lots of about 400 tons, stored in B1160 of 800 m3). PET coke is normally dry, fine and dusty and will be transported in silo trucks to the facility on 5 days per week of normal production. PET coke will be stored in the silo B1050 (120 m3). Pay loaders execute the handling of the coarse (wet) materials inside the mixing plant building (A9100; transport from the boxes to the dedicated box feeders of each 10 t capacity).

3.50. For the adjustment of the slag basicity small amounts of sand or lime might be required depending on the composition of the EAF.D. Lime will be supplied in silo trucks, stored in the silo B1060 for direct mixing with EAF.D in the mixer R1300. Sand will be supplied in tip trucks, stored in box (B1150) for direct feeding to the kiln via box feeder (1524)..

Other Consumed Material:

- Diesel for onsite movable equipment like pay loaders, received in tanker truck, stored in tank B8250;
- Industrial fuel oil for the start up burner (D2110) and the emergency generator (Y8900), received in tanker trucks, stored in tank B8260;
- Industrial process water for mixing/agglomeration of SRP and pellets in mixer (R1300) and for evaporation cooling (2-phase spray nozzles X2260 in DSC F2200, cooling tower W2400, water spray X2690 in cooling drum W2600), received at the beginning of operation in tanker trucks, stored in process water tank B8615;.
- Lignite activated coke (HOK/AC) for dioxin adsorption, received in 2 m3 big bags supplied in 40 feet container.

3.51. Plant will generate 2 products by its pyro-metallurgical process: Waelz Zinc Oxide (WZO) and Waelz Iron Product (WIP). WZO is a fine powder rich in ZnO. It is buffered in two 120 m3 silos (B3810/20) before being packed into double layer big-bags of 1200 kg net weight. Up to 2000 big bags can be temporarily stored inside the WZO building (A9400) before a lot is shipped to overseas customer either as gross bulk or in 20 feet container. Optional the buffer silos can be equipped with silo truck filling devices for bulk shipment to local customer as soon as available. The coarse, iron-rich WIP is temporarily stored in the covered WIP storage building (A9700, about 3000 m3) before expedited by tipper trucks to customers in the cement or steel industry.

3.52. Below Table 3.2, shows the annual and monthly quantity of raw materials used at the GSD Gulf Ltd. Table 3.3 depicts the annual and monthly product and by product quantity

Table 3.2: the raw material used in plant

Material	Used in	storage	Annual quantity in tons	Maximum monthly quantity in tons	Type (Liquid, solid, gas)
Fresh EAF Dust	Mixing / Waelzkiln feed	Silos / boxes in closed building	72,500 – 100,000	7,000 – 8,000	Solid
Stored EAF Dust	Mixing / Waelz kiln feed	Boxes in closed building	27,500 (decreasing)	3,500	Solid
PET coke	Mixing	Silo	10,000	1,125	Solid
Coke breeze or anthracite	Mixing / Waelz kiln feed	Boxes	14,750 (wet)	1,550 (wet)	Solid
Hydrated Lime	Mixing	Silo	7,000	575	Solid
Sand	Waelz kiln feed	Box in closed building	1,000	150	Solid
Lignite activated coke	Adsorption filter	Big bags in container	100	12	Solid

Table 3.3: annual and monthly quantity of product and by product

Material	Chemical formula	Used in	Storing place	Annual quantity in tons	Maximum monthly quantity in tons	Type (Liquid, solid, gas)
Waelz Zinc Oxide	ZnO mixed with PbO, NaCl, KCl and impurities of NaF, FeO, CaO, SiO_2 and sulfate	Secondary raw material in zinc smelters for the production of Zn metal	Silos / big-bags in closed warehouse	36,000	4,055	Solid
Waelz Iron Product	Fe/FeO mixed with gangue (SiO_2, CaO, MgO, Al_2O_3, MnO) and some fixed carbon	Steel industry for production of steel Or Cement industry as iron oxide additive	Closed storage building	73,000	8,250	solid

Emissions

Dust / Particulate Matter (PM)

3.53. Flue dust (PM) is generated in the Waelz kiln by the volatizing of the non ferrous metals and their re oxidation in the supposed free board. This dust is the recycling product, crude Waelz zinc oxide (WZO). The major component is zinc oxide (ZnO), but also lead oxide and Zn/Pb compounds (e.g. PbO, ZnSO4, ZnCl2, PbCl2, PbS or PbSO4), evaporated / sublimated salts (e.g. NaCl, KCl & NaF) and carry over from the feed (e.g. SiO2, CaO, FeO & C) are also produced. The dust is very fine (below 100 micro meter diameter).

3.54. In order to collect the dust state of the art bag house filters would be installed. They have a proven sophisticated design, a relative high filtration surface and are equipped with cloths having a special PTFE surface treatment. This kind of bag house filter guaranties high filtration efficiency of more than 99.5 %, which limits the emission of PM to less than 4 mg/m3 (standard, dry).

Sulfur Dioxide (SO2)

3.55. The sulfur dioxide is the oxidation product of sulfur in the Waelz kiln. Sulfur is fed to the kiln by the reducing agent coke breeze or PET coke and is also containing in the treated EAF.D. Due to the high lime (CaO) content in the EAF.D most of the fed in sulfur is bound in the solid matter of the kiln and becomes part of the Waelz Iron Product mainly as CaS/CaSO4 and FeS.

3.56. Partly, the sulfur reacts with lead and forms volatizing PbS, which is sublimated and oxidized to PbSO4. Only a minor part leaves the kiln as gaseous SO2 with the flue gas. Most of that is adsorbed by the fine ZnO particles on the surface of the bags in the bag house filters. The capture of sulfur in the WIP and the adsorption of gaseous SO2 by ZnO reduces the atmospheric emission to maximum 50 mg/m3 (standard, dry) even on high sulfur feed and to normally less than 30 mg/m3 (standard, dry).

Nitrogen oxides (NOx)

3.57. NO is the product of oxidation of nitrogen (79 % in air) at high temperature (significant above 1800 °C) and excess oxygen. Due to the fact, that Waelz process is a metallurgical reduction process with low excess oxygen and that the applied temperature is more moderate than in an incinerator or combustion process, the formation of NO in the Waelz kiln is negligible. Only during the heating-up (when the burner is used) some NO is formed. Consequently, during the normal operation the NOx emission is less than 10 mg/m3 (standard, dry, as NO2) with maximum values up to 50 mg/m3 during the operation of the burner under high load (temporarily during the heating up, but flue gas volume is then significantly lower than during normal operation).

HCl

3.58. Though the EAF.D feed contains some chlorine (average about 2.7 %) the formation of gaseous HCl is negligible in the Waelz kiln because the chlorine reacts faster with the volatized non-ferrous metals (mainly Zn, Pb) or is already bound to alkaline metals (Na, K) and volatized as salts. Consequently, nearly all the fed in chlorine is going in the crude Waelz zinc oxide and the gaseous emission of HCl is less than 5 mg/m3 (standard, dry).

Hydrogen Fluoride (HF)

3.59. The content of fluorine in the feed, mainly in the EAF.D, is quite low (average less than 0.2 %) and it is partly bound to lime, which cannot be decomposed in the Waelz process. The volatized part of fluorine is reacting with sodium to form a NaF salt, which is captured in the crude Waelz zinc oxide product. Consequently, the gaseous emission of HF is less than 1 mg/m3 (standard, dry).

Mercury (Hg)

3.60. A very small amount of mercury is present in the EAF.D (maximum 5 ppm). This is volatized in the Waelz kiln and leaves the kiln with the flue gas. Thanks to the use of activated carbon for dioxin reduction, the Hg can be also adsorbed in the pores and captured. Therefore, the gaseous emission of Hg is less than 20 µg/m3 (standard, dry).

PCDD/F (Dioxin)

3.61. The reducing conditions and the temperature in the Waelz kiln are suitable to destroy dioxins and furans (PCDD/F), which might be fed in with the feed. But during the cooling procedure in gas treatment the reformation by the so-called de novo synthesis occurs. This happens in a temperature window between 500 and 250 °C. In order to reduce the formation of PCDD/F a rapid cooling by ambient air in the mixing cyclone is applied: in less than 2 seconds the critical temperature zone is passed.

3.62. This primary measure is combined with a 2 stage adsorption process using activated carbon (AC) or hearth oven coke (HOK) as adsorbent (these materials have a specific surface of 300 m2/g providing pores for the adsorption process). The first adsorption step takes place in the production filter and a second in an additionally installed adsorption filter. Fresh adsorbent is mixed to the flue gas upstream of adsorption filter together with a small quantity of WZO for increasing the surface on the filter bags. The collected adsorbent is re fed up to 10 times into the flue gas before it is taken out and injected upstream of the production filter for the first stage adsorption. The inner surface of the adsorbent is so high that it cannot be saturated in this process and always provides enough "empty" pores for further adsorption

3.63. This way of dioxin treatment / reduction was first successfully applied at a Waelz plant in France in 1999 and is now a proven technique used in several similar plants around the world (e.g. in Germany, Taiwan and Brazil). The dioxin emission is guaranteed to less than 0.1 ng/m3 I-Teq (standard, dry).

Environmental Aspects

3.64. The most important aspect of the Waelz Kiln technology is that the plant does not release any process solid, liquid and gaseous waste. However it generates some quantity of maintenance waste like spent lubrication oil, greases, defect parts etc. and other office generated waste i.e paper and packing material is generated. Waelz Kiln releases clean air into the ambient air after the treatment.

3.65. Along with the product as zinc oxide, a co-product Waelz Iron oxide also produces, which can be used directly in road construction, civil construction (backfilling), cement manufacturing or can be reprocessed to add more value to the iron content which is currently under research and development.

3.66. The dust free off gas is treated, filtered and discharged; the discharged air easily meets strict US and European environmental regulatory standards and is a major supporting factor in the US EPA designation as Best Demonstrated Available Technology and the EUs designation as Best Available Technique.

3.67. In conclusion it can be stated that the plant would be designed to meet all national and international environmental emission/discharge standards.

4. THE NEED FOR AND SCOPE OF ASSESSMENT

Need and environmental impact Assessment category

4.1. The legislative requirements of Saudi Arabia require that major projects shall be the subjected to adequate Environmental Impact Assessment.

4.2. The national legislation sets out three categories of EIA project. Category 1 projects require the lowest level of assessment whilst Category 3 projects require a full EIA. Category 2 sits between these two with a requirement for limited assessment and completion of a standard form.

4.3. The determination of category depends upon a number of factors but principally is based on an assessment of the risk of significant environmental effects occurring because of the project development. The main factors in determining the level of risk are the size and nature of the project and the sensitivity of the receiving environment.

4.4. The current project has been determined as a Category 3 EIA project and the EIA has been conducted in accordance with this categorization.

4.5. Given the diverse range of elements of this project a cumulative impact assessment has also been conducted. This is based mainly on cumulative land take, air quality and dust emissions, waste management and general resource usage.

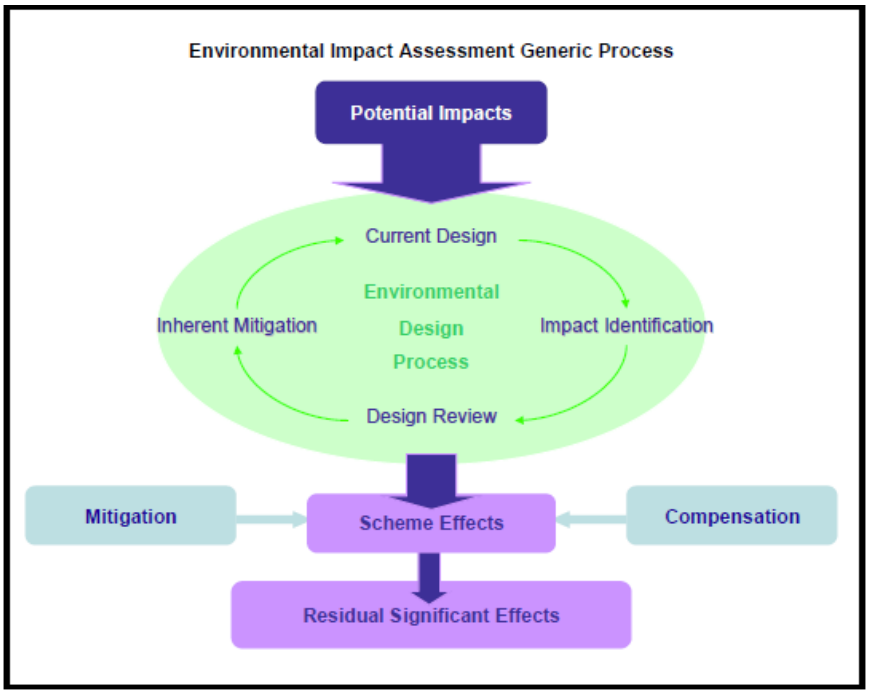
Assessment method and scope

General Approach

4.6. The methodology of the study considered the national and international related legislations on Environmental Impact Assessment and best practice guidance. The detailed method is shown in Section 7.

4.7. The aim of any environmental impact assessment process must be to identify potential impacts on the environment and if possible alter the design of the project to remove the potential impact. This is termed inherent mitigation, and through this iterative process of impact identification and design review it is possible to minimize potential impacts of any project. A diagram showing this generic approach is provided in Figure 4.1.

Figure 4.1 Generic approach to EIA



4.8. A project can have potential significant effects on a wide range of environmental receptors. The importance or significance of these effects depends upon a number of factors, principally the level of magnitude of the impact and secondly the sensitivity of a receptor to be affected by the impact

4.9. It is therefore important to identify those processes or actions which will lead to an impact (i.e. a change in the environment); evaluate the magnitude of this change and then identify any environmental receptors upon which the impacts may act. It is this product of the impact acting on the receptor which produces an environmental effect. The significance of the effect is then determined by comparison, wherever possible with a nationally or internationally accepted standard. If no standards are available then it is necessary to develop project specific limits.

4.10. Such standards or limits are referred to as the **Significance Threshold**. The threshold standards used for the assessments within this study are provided in the specialist chapters. Where the size and type of effect is greater that the significance threshold, then this is termed a **Significant Effect**. Such effects are sometimes further defined, often as High, Medium and Low.

4.11. Identified significant effects need to be reported in the Environmental Impact Assessment Report and if possible avoided or mitigated to reduce the effect to an acceptable level.

Scope of Assessment

4.12. Scoping is the single most important stage of an environmental impact assessment process. In scoping it is necessary to understand the project and the receiving environment to a sufficient extent that predictions can be made as to whether a Significant Effect is likely to occur for any of the topics normally included within an EIA process. These include:

- Agriculture – fish – soil
- Air quality
- Archaeology and cultural heritage
- Community and socio-economics;
- Contaminated land;
- Ecology;
- Landscape and visual;
- Noise and vibration;
- Recreation and leisure;
- Road traffic and transportation;
- Waste and material resources;
- Water resources; and
- Cumulative effects

Project Specific Scope

4.13. It is neither normal, nor desirable that all topics are studied to the same depth in all EIA's. If at an early stage it can be identified that no significant effect is likely to occur for a topic then it should be scoped out of the full EIA process. This enables better use of resources to be focused on those topics which could have significant effects.

4.14. The following scope was based on the identified environmental aspects of the operational phase and the possible impacts of the construction and operation phases, with an awareness of the likely sensitivity of the various elements of the receiving environment and relevant legislative requirements.

- Air Quality;
- Noise and Vibration;
- Health and safety
- Soil and groundwater; and
- Waste Management

Assessment methodology

4.15. The determination of the significance of an impact has been conducted in a systematic manner. Having identified the environmental aspects of the project; i.e. those aspects of the project which have the potential to give rise to a significant impact on the environment, it is necessary to identify the environmental receptors which may be affected by the impacts of the project. This process has been partially conducted during the initial scoping phase of the project but is finalized during and after the baseline characterization phase.

4.16. That is, once adequate information regarding the site and the surrounding area is obtained the receptors which may be sensitive to changes in environmental conditions can be identified and listed.

4.17. Using a two dimensional matrix the factors of environmental aspect and sensitive receptors are compared to identify possible interactions which may lead to environmental effects which are significant

Thresholds and Significance Criteria

4.18. As previously noted the importance of an environmental change is assessed in terms of its significance and if it exceeds a preset threshold of change. In this assessment the legislative requirements of the Presidency of Meteorology and Environment have been used as the basis for establishing the threshold of significance. Where such legislative thresholds are not available then this assessment either uses percentage change in the existing situation or if the change cannot be enumerated a professional opinion is used.

4.19. Where a legislative standard is exceeded then the effect is considered to be of HIGH Significance. A change in environmental conditions which causes a 10% change in existing conditions for environmental parameter acting on a sensitive receptor is deemed to be an effect of MODERATE Significance. A change of 5 % is termed an effect of LOW Significance. Below this threshold impacts are considered to be non significant.

5. BASELINE CONDITIONS

Location

5.1. Plant is located within the borders of the Second Industrial City in Dammam. The industrial city has been developped especially for industrial and manufacturing facilities. GDS Gulf plant is located on the far eastern border of the industrial city with an approximate area of 48 976 square meters.

5.2. The general location position within the Kingdom of Saudi Arabia have been indicated in Chapter 3, see Figure 3.1. The geographical location is approximately at latitude 26°16'25.98"N and longitude 49°57'35.16"E.

Geology, topography and substrate

5.3. The exposed rocks of the Dammam dome range in age from Palaeocene to middle Miocene. At the core of Dammam dome both the lower and upper Rus Formations (Tleel, 1973)1 are present. The lower Rus is made up of alternation of marls and thin dolomite limestone beds with abundant slumps and geodes. The upper part of the unit is vuggier weathered calcarenite with abundant mud balls. Jointing is more pronounced in the upper part of the lower Rus Formation due to the nature of the rock. The upper Rus Formation is mainly made up of fine grained chalky limestone with few marls and clay layers at the top. Figure 5.1 shows a simplified geological map of the Dammam dome of the Eastern Province of Saudi Arabia.

5.4. The depositional environment of Rus Formation consists at the base of sabkha, which subjected episodically to shallow marine incursions and changes towards the top of the Formation into regressive facies, lagoonal associated with continental facies (Weijermars, 1999). The Rus Formation is overlaid conformably by Dammam Formation.

5.5. Dammam Formation is subdivided into five members; Midra shale, Saila shale, Aveolina limestone, khobar and Alat members of dolomitic marl and dolomitic limestones. The four lower members of the Dammam Formation are present in a small ridge at the core of the Dammam dome (Weijermars, 1999). The Dammam Formation represents a transgressive facies sequence (Weijermars, 1999)[1]. The sabkha and sub tidal to continental lagoon facies were progressively transformed into an open shallow marine environment.

5.6. The Miocene Hadrukh Formation fringes the outer rim of the Dammam dome and comprises sandy marl at the base with intercalations of thin limestone beds, and sandstone. Towards the top the facies changes into calcareous sandstone and shales interbedded with minor amounts of marl and gypsum.

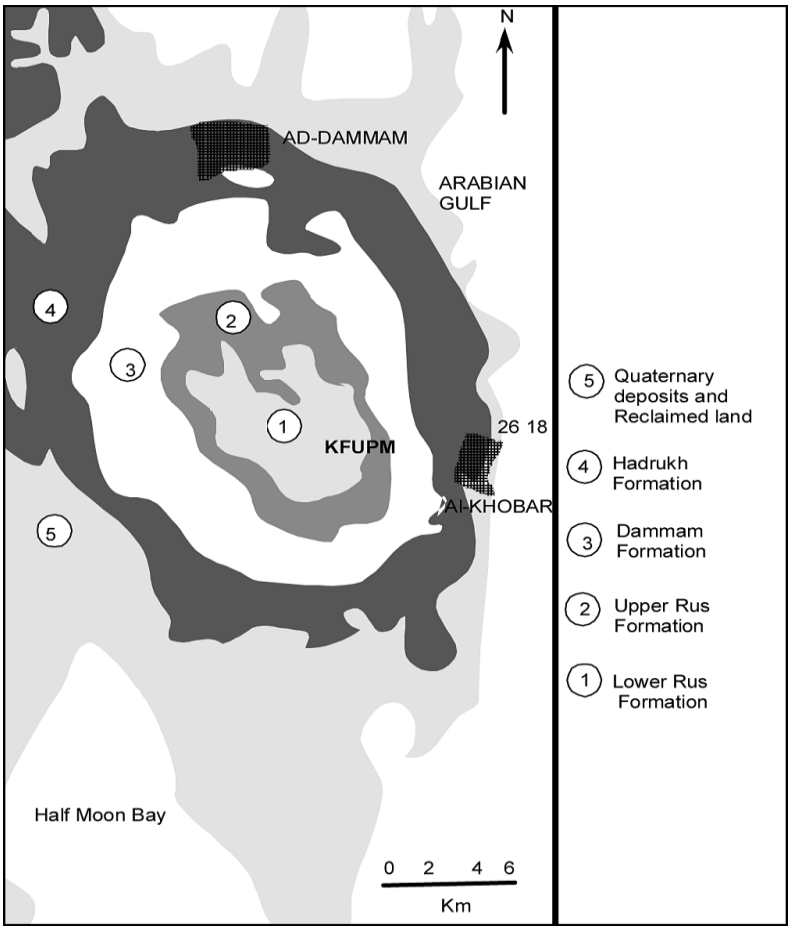
5.7. The Hadrukh Formation represents continental to shallow marine facies (Power et al., 1966; Weijermars, 1999). The Dam Formation uncomfortably overlies either Rus or Dammam rocks, depending upon location. At Jebel Midra Al – Janubi the Dam Formation comprises sandy conglomerate at the base overlain by stromatolitic limestone. The middle part of the sequence is dominated by clastic limestone, and intercalations of microcrystalline limestone with calcite geodes. In the top of the sequence consists of massive calcrudite, with ancient subaerial collapsed dissolution caves. This facies changes up into massive reef limestone.

[1] http://faculty.kfupm.edu.sa/ES/mmhariri/New%20Folder/Copy%20of%20UseGIS-Delineate%20Lineamnts.pdf

5.8. Dam Formation indicates a major marine transgression, and it shows shallow marine environment (Weijermars, 1999). Shallow subtidal to intertidal environment is also indicated at the type locality of Al - lidan escarpment (Irtem, 1996)[2]. Quaternary coastal deposits, Sabkha plains and eolian sands ar e covering the low area at the peripyries of Dammam dome and large alluvial fans of conglomerate and sand deposited within major wadies (Weijermars, 1999).

Figure 5.1 Simplified geological map of Dammam dome

(Weijermars, 1999; Stieneke al., 1958; Tleel, 1973; Roger, 1985)

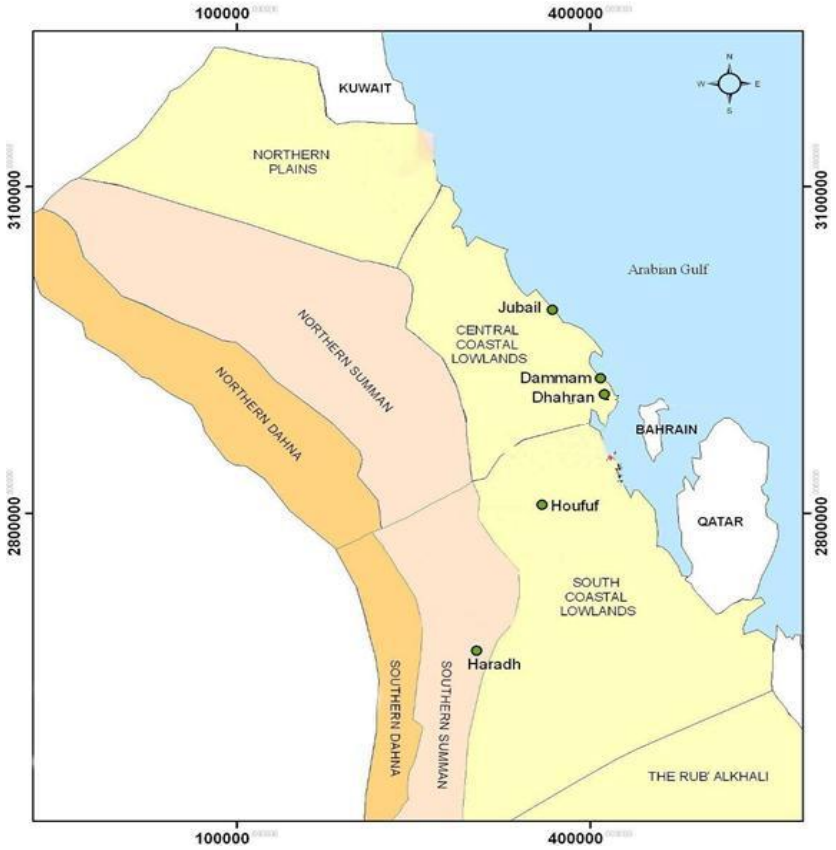


5.9. The eastern region lies on the Arabian Gulf coast and contains salt flats (sabkhahs). There are many artesian wells along the coast which are used to

[2] http://faculty.kfupm.edu.sa/ES/mmhariri/New%20Folder/Copy%20of%20UseGIS-Delineate%20Lineamnts.pdf

irrigate large areas under cultivation around Hofuf and Qatif. Figure 5.2 shows the topographic regions of eastern Saudi Arabia (Mandaville, 1990[3] and KFUPM/RI, 2006b[4]).

Figure 5.2 Topographic regions of Eastern Province of Saudi Arabia



5.10. The area around Dammam is characteristic of the coastal plains. The sands vary from coarse gravelly sands to fine windblown sand over limestone, which may outcrop in some areas. The surficial conditions consist primarily of flat areas with sandy soil.

[3] Mandaville, J.P. (1990). Flora of Eastern Saudi Arabia, Kegan Paul International Limited, England

[4] KFUPM/RI (2006b). Summary Report (Terrestrial Ecology) Environmental Services for Southern Area Seawater Capacity Expansion (SASCE) Project. Prepared for the SNC-Lavalin Inc. by the Center for Environment and Water, Research Institute, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia, Report No. CEW2327.

Translated from Arabic

Climatology

5.11. The climate of Saudi Arabia is described as arid[5]. The climate of Eastern Saudi Arabia is typified by low rainfall for much of the year with high temperatures. Saudi Arabia is experiencing a trend in rising maximum and minimum temperatures based on evaluations of data from 1950 to 2003[6].

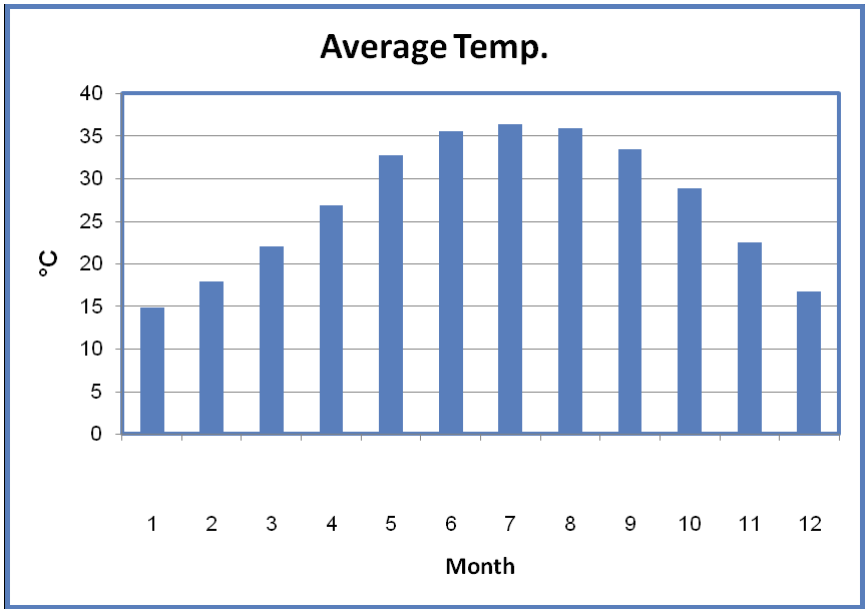
5.12. It is not unusual for the relative humidity to register more than 85%, and may reach 100% for extended periods, thereby creating a feeling that the temperature is substantially warmer (i.e., heat index).

5.13. Table 5.1 represents the climatologically data for the Arabian Gulf coastal region. These data were collected by PME at Dhahran.

[5] Schyfsma, E. 1978, Climate – in Quaternary Period in Saudi Arabia 1: Sedimentological, Hydrogeological, Hydrogeochemical, Geomorphological and Climatalogical Investigations in Central and Eastern. Pages 31 – 44 Eds, Al-Sayari, S.S. and Zötl, J.G.

[6] Zhang, X., et al. (2005), Trends in Middle East climate extreme indices from 1950 to 2003, J. Geophys. Res., 110.

Table 5.1: Climate data [Arabian Gulf coastal region (2011)]



Wind patterns

5.14. On a macro-scale, the prevailing winds in the eastern area are normally generated by the interaction between weather patterns that are located over the interior of Saudi Arabia and the Arabian Sea or Gulf of Oman - i.e. high pressure over Saudi Arabia and low pressure over the Arabian Sea/Gulf of Oman. This generally creates winds from a northerly direction.

5.15. Prevailing winds in the eastern province of Saudi Arabia are from a northerly (north-northwest through north-northeast) direction. When the pressure gradient between the coastal region and the interior becomes unstable, wind is generated and the coastal areas are cooled during the summer months. During the winter, southerly winds, when they occur, are referred to as a "kauf", and generally bring an increase in temperature and humidity. Strong northwesterly winds in late spring and early summer create "Shamals". These wind storms can be particularly severe in the eastern province and may occur over a period of several months. During a Shamal, winds speeds can

range from 40-50 km/hr with gusts up to 100 km/hr. Strongest Shamal winds typically occur in February.

5.16. Additionally, climatic conditions of Saudi Arabia are further strongly influenced by the location of the Intertropical Convergence Zone (ICZ) and reversing winds of the Indian Monsoon. During the winter months in Saudi Arabia the ICZ and associated rain belt are located south of the equator. The atmospheric pressure gradient created due to high pressures on the Eurasian continent and the low pressure ICZ over the Southern Indian Ocean result in moderate northeasterly winds blowing across Saudi Arabia.

5.17. Figure 5.3 indicates Annual wind Circumstances coming to Dammam

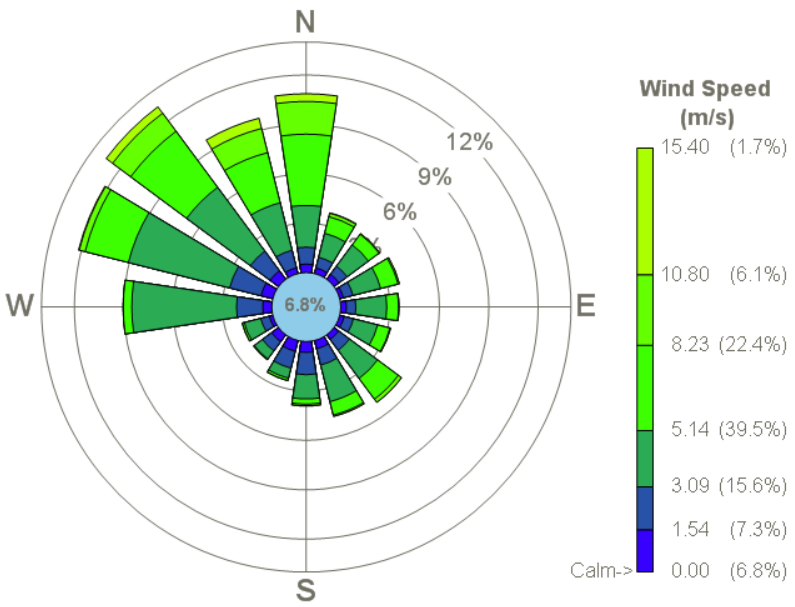


Figure 5.3 Dammam Wind Rose diagram

5.18. Dammam / Dhahran / Khobar climate is also influenced by its proximity to the Arabian Gulf causing peak temperatures to be ameliorated. This temperature reduction is however matched with very high humidity levels. Fog can also form (predominantly in August) when cooler humid air mixes with warm air off the sea.

5.19. It can be seen that GSD Gulf Ltd. may experience relatively strong winds with both the strongest and the most frequent from a northerly direction. This is particularly true during the early summer months when the Shamal (North) wind blows bringing sand storms and low visibility conditions.

Noise Level Survey

5.20. The objective of the baseline noise survey was to establish the existing sound levels at the project site.

5.21. Baseline noise monitoring was carried out on October 13, 2012 using a Rion NL31 Type 1 Precision Sound Level Meter. Two sites were selected on the land and noise levels were measured over a 5 minute period. The sound level meter was calibrated before and after measurements using a Rion Type NC74 acoustic calibrator. Tables 5.2 show the recorded values for the main factors[7]:

Table 5.2: Baseline noise survey results

Location	Co-ordinates	Date and Time	Mon. Time (min)	LAeq	LAE	LAmax	LAmin	LA05	LA10	LA50	LA90	LA95
N1	26°16'27.56"N 49°57'37.76"E	10/13/2012 10:28	0:05:00	42.1	52.0	45.8	39.9	45.5	45.1	42.6	40.4	40.2
N2	26°16'24.48"N 49°57'32.57"E	10/13/2012 10:35	0:05:00	52.6	62.4	55.2	49.5	54.8	54.5	52.0	50.2	49.9

[7] LAeq = Equivalent continuous A-weighted sound level

LAe = A-weighted sound exposure level

LAmax = Maximum A-weighted sound level

LAmin = Minimum A-weighted sound level

LA05, LA10, LA50, LA90, LA95 = Percentile A- A-weighted sound level

Translated from Arabic

5.22. Figure 5.4 represents sound monitoring location in the proposed project site for the Global Steel Dust Gulf Co., Company

Figure 5.4 Locations of Noise Monitoring Points

Baseline monitoring results

5.23. Two (2) monitoring locations were selected to establish the existing baseline noise levels for the project site. The minimum and maximum noise level results at two monitoring points are 39.9 dBA & 49.5 dBA, and 52 dBA, and 62.4 dBA respectively.

5.24. The above noise data shows that it is under the national standard; however, noise level impacts are expected to increase during construction phase. Natural contributors are nearby factories, traffic and human activities. However, the impact is temporary and localized. The noise level can be minimized by restricting noisy activities during daytime only.

Contaminated land

5.25. A visual site survey was conducted on September 26 & October 13, 2012 within the proposed project site showed no evidence of contamination of soils.

Waste

5.26. Most of the project elements will produce construction waste. This will be in the form of solid waste.

5.27. An appropriate waste management plan is provided in Section 8.

6. AIR DISPERSION MODELING STUDY

6.1. GSD Gulf Ltd. proposes to construct and operate an Electric Arc Furnace Dust Recycling Plant in the Second Industrial City of Dammam, Saudi Arabia. The plant is proposed to include a Waelz Kiln for recycling of steel dust which will be collected and transported in silo trucks to the GSD Gulf plant. The Waelz Kiln technology releases clean air into ambient air which follow the international standard. However, for the assessment of air dispersion as part of an Environmental Impact Assessment (EIA) study an air quality modeling has been prepared. This air dispersion modeling study has been prepared by Arensco's consortium in Canada named "EnviroRisk".

6.2. This report describes the air quality assessment that has been completed for the proposed EAF.D recycling plant. The potential air quality impacts are considered under normal continuous operating conditions.

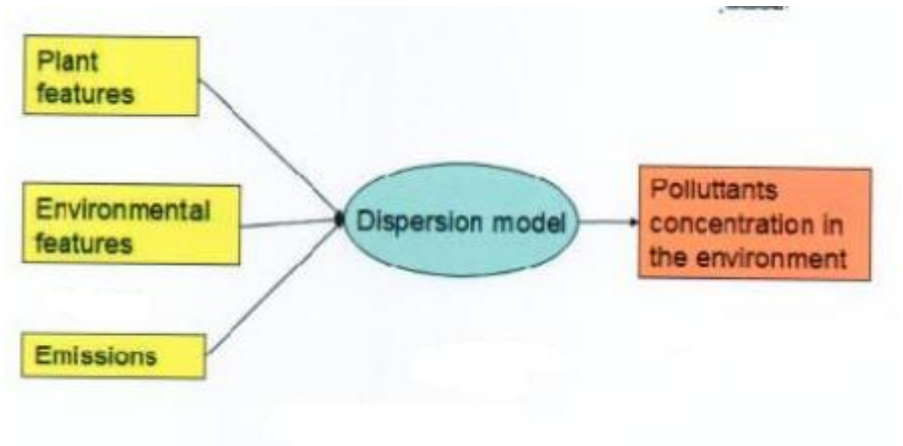
6.3. The dispersion of pollutants in the air is influenced by several factors related both to the nature of emitted pollutants and their physical properties both to the plant characteristics and geographical properties of the zone for which the model is applied. On the basis of this information an air dispersion model simulates the behavior of the observed gas in the atmosphere and calculates their concentration in the atmosphere. For the purpose of the work the average ground level concentration of the following set of pollutants established::

- Nitrogen oxides
- Sulfur dioxide
- Total suspended particles
- PM10
- PM2.5

- carbon monoxide

6.4. This set of pollutants corresponds to the main emissions produced by a standard plant and mainly affect air quality. A schematic representation of the input-output of the adopted air dispersion model.

Figure 5.6 Air dispersion model



6.5. Air dispersion models simulate by means of several mathematical equations and algorithms how the pollutants disperse in the atmosphere. These equations are based on: meteorological conditions (wind speed and direction, stability class of the particular atmosphere, air temperature profile); emissions parameters such as source location and height, stack diameter and exit velocity, exit temperature and mass flow rate; terrain morphology (i.e. elevation of the zone surrounding the emitting plant); the presence, positions and dimensions of buildings or other structures which can affect the path of the emission.

6.6. AERMOD is the most known and widely used Gaussian air dispersion model.

6.7. A complete Air dispersion model report was performed.

6.8. The model covers an area of 20 Km x 20 Km around plant.

6.9. The emissions, which have been modeled, are SO2, NO2, and Total suspended particles (TSP).

6.10. According to the concentrations of these emissions corresponding to the hour, day and year.

6.11. The results of TSP emissions shows that its amounts ranged between 63-83, 2.35-3.3, 0.105-0.56 micrograms /m3 for the periods of the above mentioned measurements respectively while the PME standards corresponding to the two periods referred to at last are 340 and 80micrograms/m3 respectively.

6.12. The result of NO2 emissions show that its amounts ranged between 5.73-4.37, 0.35-0.71, 0.116-0.140 micrograms for the periods of above-mentioned measurements and for above mentioned years; while the PME standards corresponding to the two periods referred to at last are 100 and 660 micrograms/m3 respectively.

6.13. The result of SO2 emissions show that its amounts ranged between 28-67, 21-84,2.63-3.53,0.578-0.698 micrograms for the periods of above-mentioned measurements and for above mentioned years. While the PME standards corresponding to the two periods referred to at last are 730, 365, 80 micrograms/m3 respectively.

6.14. Emissions modeling of stacks No. 7 and 18 during the plant operation phase showed that emissions concentrate in the plant area and dispersed toward south-eastern due to prevailing wind effect. The concentration of such emissions is much lower than PME and other related international standards.

7. ENVIRONMENTAL IMPACT AND MITIGATION MEASURE

7.1. This section predicts the environmental impacts as far as possible and to propose measure, which will be incorporated in the project design, installation and commissioning, if not eliminate, at least mitigate these impacts. This is the essence of any environmental impact assessment.

Method

7.2. The generic approach to the assessment process was set out in Section 4. The detailed method is shown below. The determination of significance depends mainly on the type and magnitude of impact and the value/sensitivity of the receptor.

7.3. A significant effect may be broadly defined as one which should be brought to the attention of those involved in the decision-making process.

7.4. Significant adverse effects occur where valuable or sensitive receptors, or numerous receptors, are subject to impacts of considerable magnitude and duration. Some effects will be temporary, others will be permanent in nature and these are stated within the assessment.

7.5. Effects are unlikely to be significant where low value or non sensitive receptors, or a small number of receptors, are subject to minor or short-term impacts. Where an effect is considered to be significant, its magnitude will generally be classified as High, Medium, Low and non significant (NS) with these descriptions being relative.

7.6. The main basis for ascribing the severity of the effect is a combination of the quality of the environmental receptor or its sensitivity to change and the magnitude of the impact.

7.7. The current assessment uses a matrix for determining the significance of an effect. This is based on five levels of Value/Sensitivity and three levels of impact magnitude; these are shown in Table 7.1. A glossary of terms used in the assessment process is provided in Appendix 1.

7.8. In determining the final predicted level of significance of an effect other factors are taken into consideration. Where possible these are objective and quantifiable factors such as the time period over which the effect will occur and the reversibility of the effect.

Table 7.1: Basic Matrix Used to Determine Significance of Effects

Site Value or sensitivity ➡ **Magnitude of Impact** ⬇	International/Extremely Sensitive	National/ Highly sensitive	Regional/ Moderately sensitive	Local/ Marginal sensitivity	Very Local/ insensitive
high	high	medium	low	low	NS
medium	medium	medium	low	low	NS
low	low	low	NS	NS	NS

7.9. Those parts of the matrix shaded are considered to represent significant effects.

7.10. Another important aspect of the assessment reporting is the confidence level of the predictions. In normal circumstances, direct impacts such as habitat loss are easy to predict and quantify, indirect impacts, such as severance or habitat fragmentation are less straightforward to predict. In this assessment the confidence level of predictions is given as either High or Low - predictions of Low confidence level do not imply a shortcoming in an assessment but a realistic acknowledgement of either a general lack of scientific knowledge (for example species distribution), or lack of preciseness of the final form of a development and method of construction.

Assessment

7.11. Table 7.2 provides a summary of the predicted impacts of the proposals on valued environmental receptors and is only presented for those project elements where significant effects may occur without mitigation.

Table 7.2: Summary of Impacts

Translated from Arabic

Sensitive environment receptors	**Value/sensitivity**	**potential impact**	**amount**	**continuity**	**Significance of effect before reduction**	**Reduction means**	**remained mark/ confidence level**
Ecology	local /marginal sensitive	Constitute a complete loss vegetation cover because of removing the site.	medium	permanent	low	Reducing the necessary land drilling operations and reducing the disorder in the region	low / high
Noise	regional / middle sensitive	Noise Increased noise levels during construction and operation phase, which affect on the temporary medium low noise plan " adjacent area management developed and implemented as part of the building intra-administration plan	medium	temporary	low	appropriate reducing noise machines will be used where available, a noisy operation will be made during the normal working hours in daylight	Neglected / high
Air Quality (PM10)	local /marginal sensitive	A fugitive air emissions during construction and operation phases	medium	temporary	low	managing the approval dust emissions site-To minimize the occurrence of disorder in vegetation cover and soil and control the Vehicle movement	Neglected / high
Soil and groundwater	Regional sensitivity/moderate	Local pollution during the construction phase	unknown	Permanent / contemporary	Low	See reduction about PM10 above re-providance with food	
Wastes	Locality/marginal sensitivity	Building wastes and solid local wastes which are produced by workers	moderate	Contemporary/ Permanent	low	Carrying out waste management plans	

Type and Quality of Air

Environmental Concerns

7.12. Construction and operation phases environmental concerns for ambient air quality in the project area include:

- Dust generation from vehicular movement;
- Emissions from construction vehicles; and
- Dust generation from earth excavation and back filling.

Impacts of the Construction Phase:

7.13. The construction activities of the proposed project could create a temporary adverse effect on the ambient air quality of the site and its surroundings.

7.14. Given the prevailing desert conditions, dust from sandstorm events, dust generation from vehicular movements and vehicular emissions are likely to be the major factors affecting air quality in the project area.

7.15. The scope and nature of the proposed project will require the use of construction vehicles and machinery such as dump trucks, backhoes, excavator, bulldozers, compactors, cranes etc. Therefore, the major construction phase impacts on the proposed project area include dust generation and exhaust emissions from vehicular movement.

Maricopa County Air Quality Department

7.16. A study conducted by the Maricopa County Air Quality Department on vehicle dust emissions on unpaved roads in the United States evaluated the effects of different vehicle speeds and types of vehicles on particulate matter emissions from traveling on unpaved and uncontrolled roads (non-use of suppressants). A section of the results from the study are provided in the Table 7.3. The table indicates higher speeds on unpaved roads will lead to higher particulate matter emissions to the air.

Table 7.3 Emission Factor PM10 from Vehicle Movement on unpaved roads

	PM10 Emission Factor (EF), lb/VMT (Vehicle miles traveled)								
Vehicle Type	**10 mph**	**15 mph**	**20 mph**	**25 mph**	**30 mph**	**35 mph**	**40 mph**	**45 mph**	**50 mph**
Heavy Duty Vehicles (Haul trucks, cranes etc.).	2.13	3.2	4.27	5.33	6.4	7.47	8.53	9.6	10.67
Medium Duty Trucks (Front end loaders, forklifts etc.)	0.57	0.86	1.14	1.43	1.71	2.0	2.28	2.57	2.85
Light Duty Vehicles (pick-up trucks, etc.)	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.33	1.47

Vehicles exhaust emissions:

7.17. In addition to dust generation, vehicular exhaust emissions from the construction phase could affect ambient air levels. The Empire State Development Corporation (ESDC) along with the City of New York and Atlantic Yards Development Company conducted a model emission rates study for a transit-oriented development project in Brooklyn, USA. CO, NO2, and PM10 emission rates were recorded for typical construction related vehicles and and machinery. Emissions rates for select construction vehicles and machinery from the study are presented in Table 7.4. The emissions rates were calculated based on the number of hours the vehicle engines would operate per day, averaged over the averaging period for each run.

Table 7.4: Emission Rates for Construction Vehicles and Machinery

Vehicle or Device	Engine Power Rating (hp)	Emission Rate at 100% Load (g/hr)		
		CO	NO_2	PM_{10}
Asphalt Paver	155	161	473	4.55
Asphalt Roller	145	164	456	4.44
Bulldozer	370	506	1190	9.27
Backhoe, Loader	110	117	174	2.70
Compressors	275	160	671	4.72
Hydraulic Truck Crane 125 – 160 Ton	500	374	1352	9.20
Crawler Service Crane 100 Ton	375	280	1014	6.90
Drill Rigs	350	377	1103	9.32
Excavators, Backhoes	100	107	158	2.46
Excavators	428	520	1296	9.31
Generators (25 Kva)	399	416	1122	9.93
Hydraulic Cranes 45 Tons	275	126	632	4.07
Front End Loader	210	205	321	4.81
Concrete Trucks	Idle and up to 5 mph	38	46.5	1.24
Other Construction Trucks	Idle and up to 5 mph	38	46.5	1.24

Data Source: Empire State Development Corporation and City of New York Emission Rates Study.

7.18. Dust generation from the construction phase could also be a health and safety concern for construction workers in the area. Therefore, safety measure must be taken during construction phase activities.

Operational Phase Impact

7.19. An operational phase activity is expected to generate air pollutants in the form of gases Dioxins/furans/, HCl, nitrogen (e.g. NO2 and sulphur (e.g. SO2) and total particulate matter etc.

7.20. A detailed dispersion modeling assessment of the potential impact of the proposed stack has been carried out using the AERMOD model. The results indicate that the PME Air Quality Standards are unlikely to be exceeded as a result of emissions from the installation of proposed EAF.D recycle plant.

7.21. The operational phase of the project is likely to involve movement of vehicles and the raw material (EAF.D) transportation. However, dust generation and exhaust emissions in this phase will be insignificant as compared to the construction phase and is therefore not expected to impact the ambient air quality in the area.

7.22. As stated above in project description, In order to collect the dust state of the art bag house filters are installed. They have a proven sophisticated design, a relative high filtration surface and are equipped with cloths having a special PTFE surface treatment. This kind of bag house filter guaranties high filtration efficiency of more than 99.5 %, which limits the emission of PM to less than 4 mg/m3 (standard, dry).

7.23. Heavy traffic in the plant yard and driveways is a potential source of dust. To minimize this problem, road vacuum sweepers shall be employed to maintain low dust accumulation in the yard and thus reduce dust emission into the natural environment. Plant yard and driveways shall be washed and swept daily.

Mitigation Measure

The Construction Phase

7.24. During construction phase, a Construction Environmental Management Plan (CEMP) is recommended to be established prior to beginning any construction activities to address mitigation, control and or monitoring measures for increase frequency of dust generation.

7.25. PME standards governing dust control should be complied during the construction phase of the project and where practicable, the following are recommended::

- Application of suitable dust suppressants (e.g. water, chemicals) on project corridors and stockpiles;
- Limiting the height of stockpiles or covered by tarpaulin sheet to avoid fugitive dust emissions;
- All the dusty areas such as unpaved access roads, parking areas, and staging areas and roads should be wetted with water especially in hot dry and windy weather;
- Controlled traffic movement (including enforcing speed limits, 5 miles/hr, and restricting overtaking of vehicles);
- Dust creating activities shall be reprogrammed to avoid periods of high winds;
- Provide awareness training in the need to minimize dust.

7.26. Overall, since the construction phase of the project is temporary, vehicular dust generation and exhaust emissions are unlikely to cause permanent deterioration in ambient air quality levels in the project area or surrounding region. Therefore, the construction phase impacts on the ambient air quality in the project area are not considered to be significant.

The Operation Phase

7.27. In operation phase, air quality standards are unlikely to exceeded PME standards as a result of emissions from the proposed plant therefore no mitigation is required. While in order to minimize the workers chance of dust-breathing, the following recommendations shall be followed:

- Reduce vehicle speeds to minimize the stirring up of settled dust by posting and enforcing a speed limit of 5 MPH;
- Pave roadways and necessary process areas;
- Sweep paved areas with vacuum sweeper, or mist paved areas;
- When handling hazardous materials, always use vehicles with enclosed cabs that have positive-pressure, HEPA (High Efficiency Particulate Air) filtered air;
- Remain inside the vehicle and keep doors and windows shut during operation; and
- Operators must always wear dust masks or respirators when directly handling potential dust producing materials.

Soil and groundwater

Environmental concerns

7.28. Construction phase environmental concerns for soil and groundwater include the following:

- Soil erosion and compaction;
- Potential contamination from any accidental spills; and
- Groundwater contamination.

7.29. Operational phase environmental concerns for soil and groundwater include the following:

- and groundwater contamination from any accidental spills or leaks during the handling hazardous materials (EAF.D); and
- Soil and groundwater contamination from handling of hazardous and non hazardous wastes

Construction Phase Impacts

7.30. The construction activities will result in the removal of soil at few locations. The removal of soil could result to soil erosion by wind action and vehicular movement.

7.31. As the project will require the use of limited number of construction vehicles and machinery such as excavators, backhoes, forklifts, cranes etc soil contamination is not considered to be significant from the proposed project.

7.32. Sanitary wastewater generated during the construction phase should be disposed by using PME approved Waste Management contractors. No direct disposal of wastes on land is expected from the project and therefore any contamination of groundwater resources is unlikely.

7.33. Fine particulate matter generated from construction activities is a health and safety concern for project. However, adherence to the health and safety standards will facilitate a safe working environment.

Operational Phase Impacts.

7.34. There are no major operational phase impacts expected from the proposed project. Activities in this phase will fundamentally involve the routine maintenance and inspection of the plant.

7.35. There are no significant environmental concerns for groundwater from the operations phase of the proposed project because the plant does not release any process industrial liquid waste. However, if during an emergency or

abnormal event, wastewater is discharged could potentially leach through the soil. However, considering such events the resulting impacts are not considered significant and unlikely to occur over the long term.

Mitigation Plan

7.36. During the construction phase of the project, the following mitigation measures are proposed:

- Design activities to consider minimizing earthmoving, excavations and earthworks to the extent possible. Where feasible, re-use excavated soils;
- Construction wastes to be managed in accordance with a Waste Management plan that must be established early in the project;
- Construct an impervious storage with appropriate secondary containment for storage of hazardous material drum or other movable materials; and
- Stockpiles of hazardous materials which may produce a hazardous leachate shall be stored, loaded or unloaded in impervious areas equipped with bunds, curbs or collection systems designed to retain leachate.

7.37. During the operational phase of the project, the following mitigation measures are proposed:

- Stockpiles of hazardous materials which may produce a hazardous leachate shall be stored, loaded or unloaded in impervious areas equipped with bunds, curbs or collection system designed to retain leachate and precipitation;
- Spills and leaks around the hazardous storage area, process plant and unloading/loading area may find way to the groundwater. However, storage area, plant floor will be made with concrete plus special protection (acid resistant bricks and antiacid epoxy painting) and hence no adverse impact on groundwater due to spills and leaks is expected;
- All the waters used for washing floors and spillage are collected in different sumps all over the plant areas;
- For any underground storage, leak detection systems should be provided. Alternatively, integrity tests must be carried out periodically to ensure there is no leakage;
- Waste management must be in compliance to PME requirements; and

- Establish an emergency plan to respond to accidents and environmental emergencies. Any spill or accidental release must be considered as an environmental incident for which correction (i.e. immediate action to resolve the situation) corrective action (i.e. actions to solve the problem) and preventative action (i.e. to ensure the incident is not repeated) must be carried out.

Flora and Fauna

7.38. During the field survey, site specific information on existing habitats was surveyed at the proposed site. Scarce (negligible) vegetation of only *Cyperus conglomeratus* has been found at the proposed site. However, due the construction of the plant there are chances of its impact on the nearby plant for scenery.

Environmental concerns

7.39. Construction phase environmental concerns for flora and fauna include the following:

- Displacement of Flora (insignificant);
- Compaction of Soil (restricting plant growth); and
- Generation of dust (leading to deposition on vegetation and inhibiting growth)

Construction Phase impacts

7.40. Displacement of flora is minor concerns for the project area as the project areas has negligible vegetation cover and further the proposed plant will be constructed in the already developed industrial area.

7.41. The compaction of soils from the use of heavy machinery and construction vehicles will inhibit plant root growth and restrict water and nutrient uptake. However, as the proposed plant will be constructed in industrial area, compaction of soil will be minimal.

7.42. Another potential concern from the construction phase includes the generation of dust from excavation and backfilling activities, and from the movement of vehicles. The dust generated will be deposited on vegetation in and around the project areas restricting development. However, as desert vegetation in these areas are typically adapted to extreme conditions such as high summer and low winter temperatures, sand storms etc., the effect of dust on flora is not expected to be significant

The operational phase impacts

7.43. There are no major operational phase impacts expected from the proposed project as there are no major activities except for routine maintenance, and inspection of plant. Therefore the impact on vegetation from the operations phase of the proposed project will not be significant.

Mitigation Means

7.44. To contain or minimize the displacement of flora and disturbance to any herd and wildlife, the following recommendations should be considered:

- Construction of temporary facilities should where practicable be limited to sites where there is negligible vegetative cover;
- In areas of relatively higher vegetation cover, construction activities should be limited to the extent possible; and
- Adequate measures to prevent exposure of any herds or local population must be ensured

Noise and Vibration

Environmental concerns

7.45. Noise will also be a concern during the construction and operation phases of the project.

The Construction Phase

7.46. There will be substantial use of construction vehicles and heavy machinery. Operation of motorized equipment during plant construction such as drilling and cutting machines, heavy moving equipment and installation of the new facility components etc. is expected to generate noise with potential to affect workers.

7.47. There are many different noise sources such as background noise, idling noise, impact noise, rotating noise, intermittent noise, howling, screeches and squeals at construction worksite that need to be controlled.

7.48. According to an Engineering Section Report by the Workers Compensation Board of British Columbia (Canada), noise levels were measured for construction equipment. Table 7.5 below illustrates typical noise levels from selected sources for construction equipment in the above-mentioned report.

Table 7.5: Noise Levels for Construction Equipment

Equipment	Sound Level at Operator	
	Average	Range
Background*	**86**	
Earth Moving		
Front End Loader	88	85-91
Back Hoe	86.5	79-89
Bull Dozer	96	89-103
Roller	90	79-93
Scraper	96	84-102
Grader	<85	
Truck	96	89-103
Paver	101	100-102
Material Handling		
Concrete Mixer	<85	
Concrete Pump	<85	
Crane	100	97-102
Derrick	<85	

Equipment	Sound Level at Operator	
	Average	Range
Power Units		
Generators	<85	
Compressors	<85	
Impact		
Pile Driver (Diesel and pnuem.)	98	82-105
Pile Driver (Gravity, Bored)	82.5	62-91
Pnuematic Breaker	106	94-111
Hydraulic Breaker	95.5	90-100
Pneumatic Chipper	109	
Other Equipment		
Poker Vibrator	94.5	87-98
Compressed Air Blower	104	
Power Saw	88.5	78-95
Electric Drill	102	
Air Track Drill	113	
Noise Standards		**Noise Levels**
OSHA (at workers ear)		85 dB (A)
Day Time Community (at property line)		65 dB (A)

The operation phase

7.49. Waelz Kiln steel dust recycling operations are inherently noisy due to the large amount of mechanical equipment, transport vehicles, physical activities, and energy usage, notably furnaces and steam. The significant sources are transport and handling of raw materials and products; the production processes involving pyro-metallurgy, proper blending of materials, pelletization, EAF.D transfer to the from silo trucks to the silos at GSD pneumatically and gas filtration operations; the use of pumps and fans; the venting of steam and the existence of unattended alarm systems.

7.50. Operation of equipment with potential to generate high levels of noise will be limited to day time. Workers assigned to jobs with high prolonged exposure to highly pitched noise will be provided with personal protective gear such as ear plugs or mufflers as appropriate.

7.51. As far as the noise generated by traffic it can be considered of no significant impacts since the material handling inside the building where the non continuous operation.

Mitigation measures -The construction phase

7.52. Contractor shall be responsible for the implementation of noise mitigation measures during the construction phase. The key measures are shown below:

- Selecting equipment with lower sound power levels;
- Installing acoustic enclosures for noisy equipment;
- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations; and
- Wearing of appropriate personal protective equipment (PPE) and ear protection equipment such as ear plug or ear muffler etc. must be mandatory

7.53. Equipment will equally be serviced to improve efficiency and reduce friction of moving parts which may generate noise to limit noise levels to less than 85 dB.

7.54. It is envisaged that the noise generated during the construction phase is not expected to cause any adverse impact if practical solution of minimizing noise or mitigation measure are implemented.

Mitigation measures - Operational phase

7.55. Following noise mitigation measure will be employed while operation phase:

- The transportation vehicles and Waelz Kiln process are the main source of noise; and
- High noise warning boards shall be displayed in areas of noise levels and ear protection will be made mandatory in this area.

7.56. However, almost the plant is enclosed and hence noise from the plant will have no adverse impacts on the existing ambient noise levels as well as no adverse impact on workers is expected.

7.57. All the possible source of vibration have been considered during the design phase and prevention system have been provided through:

- elimination, or reduction of the vibration at source by selecting proper equipment
- isolation of the vibration source from the receiver (breaking the transmission paths) by using pneumatic suspensions for vibrating equipment like hammer mills, vibrating screen or vibrating dumpers for fans.

Other project Elements

7.58. The remainder of the project elements is not considered to give rise to significant environmental effects. Due to the existing nature of the facility and the fact that the area is already industrial in nature, the magnitude of the proposed works and the type of work conducted is similar to the existing land use. The main issue for this project will be air quality (i.e. fugitive dust) and waste management.

7.59. The majority of the potential impacts will occur during the construction phase of the proposed project. As part of the overall project mitigation a Construction Environmental Management Plan (CEMP) will be developed and implemented. As part of this it is recommended that an environmental site manager should be appointed to the project. ESM will be responsible for the successful implementation of the project and its environmental performance.

Cumulative impacts

7.60. The assessment of the individual elements suggests that provided mitigation is implemented then no significant effects will occur. An appraisal of the possible cumulative impacts has been undertaken for all of the project elements and envisages that the contributions to the cumulative impact from the project are not considered significant. The cumulative impact of this project along with other projects within the area has not been conducted. Such a study will require a higher level strategic environmental assessment to bring together information from all projects which will be occurring in the same temporal periods and location.

7.61. The main concern for the current project would be the air quality and the overall production of wastes. This will need to be removed from site to licensed facilities. It is not considered that this will lead to a significant cumulative effect on waste management capacity.

8. WATER AND WASTE MANAGEMENT

8.1. Waste management in the Kingdom is carried out by several governmental agencies. The Ministry of Municipal and Rural Affairs (MOMRA) is tasked with managing municipal wastes generated in the Kingdom.

8.2. PME, as the regulatory authority, is tasked with overseeing the waste management program in the Kingdom and its responsibilities include establishing policy, procedures and standards, periodic review of waste management practices, and evaluating and approving disposal and treatment facilities. PME's requirements for waste management are provided in Article 12 and in the Hazardous Waste Rules and Procedures of the General Environmental Regulations.

8.3. PME requires all project contractors to use only approved waste management contractors for collection, treatment and or disposal of hazardous and non hazardous wastes generated during project activities.

8.4. The General Environmental Regulations (GER) from the PME stipulates that that all wastes are handled and disposed of properly. The contractor will be obliged to adhere to these standards.

> *"Without prejudice to the environmental impact evaluation study, licensing of new projects, major modifications to existing projects or projects with specific expired investment terms shall require public, concerned and licensing agencies and persons implementing such projects to undertake, prior to commencing their activities, to employ technologies which are the best, internationally tried and most suitable for the local environment; the least environment-polluting materials; and appropriate treatment techniques for post operation wastes and emissions harmful to the environment in accordance with the environmental standards".*

8.5. A Waste Management Plan (WMP) must be established early in the project execution separately for the construction and operational phases of the project.

8.6. The WMP must at a minimum address the following:

- List of hazardous and non-hazardous wastes that will be generated during the project in line with PME regulatory requirements;
- Disposal options for the hazardous and non hazardous wastes; and
- Identify PME licensed Waste Management contractors authorized to collect and dispose or treat the wastes.

8.7. Waste management will be based on the hierarchy of Reduction, Reuse, and Recycle in order to minimize the amount of waste to be disposed of at landfills and the cost for disposal of the materials.

8.8. The potential environmental impacts associated with the handling and disposal of waste arising from the construction and operation of the proposed project are summarized as follows:

- evaluate opportunities to reduce, reuse and recycle waste;
- estimation of the types and quantities of the wastes to be generated;
- assessment of the secondary environmental impacts due to the management of waste with respect to potential hazards, air and odor emissions, noise, wastewater discharges and traffic etc; and
- assessment of the potential impacts on the capacity of waste collection, transfer and disposal facilities.

8.9. There must be segregation of solid wastes on site. Non-hazardous solid wastes and sanitary wastes should be separately collected and disposed by waste contractors as appropriate.

8.10. Hazardous wastes and expired chemicals should only be stored in designated areas with appropriate containment and accurate labeling. Records of generation rates and disposal of waste will be maintained and hazardous waste management areas will only be accessed by authorized personnel.

8.11. Only authorized hazardous waste disposal contractors will collect and dispose the waste in accordance to the GER of the PME. A system of waste manifests will be implemented so that all waste transits such as hazardous / non-hazardous, expired chemical, liquid waste etc and final disposal locations are known and recorded.

Water Management

Water Processes

8.12. There is industrial process required for the mixing/agglomeration of SRP and pellets in mixer (R1300) and for evaporation cooling (2 phase spray nozzles X2260 in DSC F 2200, cooling tower W2400, water spray X2690 in cooling drum W2600) received at the beginning of operation tanker trucks stored in process water tank B8615.

8.13. Waelz Kiln technology recycles all the wastewater and does not generate industrial wastewater. However, In case there is any wastewater generated and should not be reused should be sent for the disposal, it shall transport, treated and disposed as PME regulations by PME licensed contractors.)

Rainwater

8.14. Global Steel Dust Gulf Company should focus its efforts to avoid mixing of storm water with the source materials in order to avoid pollution of storm water/rainwater. Storm water is precipitation from rain and flow over land or impervious surfaces and does not percolate into the ground[8].

8.15. All above ground tanks, EAF.D and product storage area (zinc oxide and co-product Iron oxide), should be provided with containment basins properly sized. The containment basin shall have the appropriate lining in order to prevent concrete corrosion.

8.16. There shall be no unauthorized disposal and or discharge of any wastewater to the ground or other water source.

8.17. Gulf Global Steel Dust Co,. Ltd has to develop a storm water management plan, and put barriers around process locations to prevent rainwater to access in operation areas. The rainwater may also be collected to use in plant operations.

Sanitary Water:

8.18. The sanitary water generated from offices, showers, lavatories and restrooms will be connected to municipal sewer system.

[8] Generally "Storm water Associated with Industrial Activity" is defined as the discharge from any point source which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw material storage areas at an industrial site.

Solid Wastes Management:

8.19. Construction activities will generate substantial amounts of scrap metal, timber, glass and other solid waste with potential to contaminate land/soil.

8.20. The Waelz Kiln process does not generate any waste. Only “maintenance” waste like spent lubrication oil, grease, defect parts etc. and “office” waste like paper and packing material is generated.

8.21. All domestic solid waste and non-hazardous industrial solid waste shall be disposed of through skips after obtaining prior approval from local Authority.

8.22. The hazardous solid waste, if any of the industrial origin should be transported, treated and disposed off in landfill according to the PME regulations by licensed contractors.

Hazardous Materials Management

8.23. GSD Gulf Ltd will store and handle large quantity of hazardous materials EAF.D, and other industrial fuel oil defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazardous materials can be classified according to the hazard as explosives; gases, including toxic or flammable gases; flammable liquids; oxidizing substances; toxic materials; radioactive material; and corrosive substances.

8.24. The level of risk should be established through hazard assessment protocols based on the types and amounts of hazardous materials present at the site. Since the proposed plant will utilizes large quantity of EAF.D, appropriate management programs that are commensurate with the potential risks must be put in place.

8.25. The overall objective of hazardous materials management should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day to day activities.

Handling of Hazardous Materials

8.26. The following measures should be taken into considerations upon handling hazardous materials:

- Provide adequate ventilation in the working and storage area to prevent build up of vapor or aerosols;
- Full chemical resistant personal protective clothing and full breathing mask shall be worn when handling chemicals;
- Containers shall be inspected for leaks or spills, rust and high temperature on a regular basis;
- All containers shall be carefully secured, clearly identified and stored;
- There shall be no smoking in the area where chemicals are being handled or stored;
- In an event of a major spillage any unauthorized persons shall be prevented from accessing the area and the appropriate authority informed within 24 hours;
- Any spillage shall be contained with appropriate absorbent materials to prevent the chemicals from reaching storm drains; sewers or other bodies of water; and
- There shall be triple rinsing of contaminated surfaces to remove all residual chemicals.

Storage of Hazardous Materials

8.27. The following measures should be taken to manage the hazardous material in the store room:

- All chemicals shall be arranged according to their respective categories and accompanied with relevant Material Safety Data Sheets (MSDS);
- Storage facilities shall be posted with the appropriate signage so as to warn people of the danger associated with chemicals;
- The store rooms shall be provided with adequate permanent ventilation to prevent the build up of hazardous or flammable vapors;
- The storehouse shall be sufficiently lit so that container labels can be easily read;
- The chemicals shall not be stored in direct contact with sunlight. Too much ultra violet light from the sun can cause deterioration of plastic containers;
- The store room shall be bunded with concrete slabs and all floors will have an impermeable surface;
- All chemicals in the storehouse shall be placed on palettes;
- First aid equipment shall be provided; and
- Emergency response equipment, including safety showers, absorbent materials, neutralizing agents will be put in place.

9. ENVIRONMENTAL MANAGEMENT PLAN

9.1. The environmental management plan (EMP) should be prepared to guide implementation of the proposed project in an environmental friendly and socially acceptable manner. The EMP will include three components:

- Mitigation Plan;
- Monitoring Plan; and
- Emergency Response Plan.

9.2. Global Steel Dust Gulf Co,. Ltd is to ensuring that any environmental affects that could result from the operation of their facility should be identified, mitigated and managed effectively. The aim of this Environmental Management Plan (EMP) is to ensure that all activities, undertaken by GSD Gulf Ltd., are environmentally sound, comply with environmental laws and environmental protection standards.

Mitigation Plan

9.3. The Mitigation Plan contains mitigation measures for all negative project impacts deemed significant. The proposed mitigation measures have been implemented as described in section 7. The impacts shall be rendered insignificant or less significant for project acceptability from both the environmental and social stand point of view. Some residual effects will however continue to manifest and these will need to be monitored as provided in monitoring plan.

Monitoring Plan

9.4. Monitoring of the project and its performance shall be carried out as part of routine project implementation to observe changes taking place in the environment and assess the effectiveness of mitigation measures put in place and the unfolding of residual impacts. This would facilitate timely interventions to correct things not going according to plan thereby preventing the occurrence of serious negative effects. The key environmental indicators to be monitored will be air, groundwater and soil contamination.

9.5. Environmental monitoring and emergency situation handling at the site shall be under the responsibility of the HSE manager and plant operator during project operation, with the help of all other plant staff. The results of the monitoring program for this project shall be used to optimize plant operations and adjust to management practices. In the event that monitoring indicates that any environmental quality is deteriorating to unacceptable levels, GSD Gulf Ltd. will correct operational procedures or undertake necessary engineering installations.

Air monitoring

9.6. The residual emissions from the proposed plant shall be monitored on a regular basis recommended as follows:

- The Plant is complying with sustained dimmer monitoring.
- PM, NOx, SO2, Dioxins/furans (PCDDF), should be monitored once every 12 months.
- Ambient air quality monitoring within site and surroundings shall be carried out for PM at least once every year at two locations (one upwind and one downwind). Depending on the results of the initial monitoring, the frequency may be reduced to once every two years.

Emergency response plan

9.7. Emergency Response Plan aimed at guiding response to emergency situations which may arise in the cause of implementing the project. The plan identifies likely emergency situations together with their causative factors followed by an elaboration of the proposed response. It is anticipated that implementation of the plan would help minimize the risks associated with implementation of the proposed project within acceptable levels.

9.8. An Emergency Response Plan should be developed provides guidance on appropriate response procedures to any emergency that may arise as a result of project implementation..

10. HEALTH, SAFETY AND ENVIRONMENT

General considerations

Exposure to raw materials

10.1. Effects of Overexposure: Electric Arc Furnace Dust under normal conditions does not present an inhalation, ingestion or contact health hazard. However, operations such as blowing, sweeping, or moving the dust may result in the following effects if exposure exceeds the exposure limits. Exposures to high concentrations of steel dusts may result in irritation of the respiratory tract and/or sensitization of the lungs and other mucous membranes. Signs and symptoms of overexposure include redness, swelling, itching, and/or irritation of skin and eyes, respiratory difficulties such as coughing, wheezing, shortness of breath, central nervous system effects, flu like symptoms, anorexia and/or weight loss.

10.2. Acute: Exposure to metal particulates can cause eye, skin, and respiratory tract irritation and/or sensitization. Ingestion of dust may result in increased levels of lead in the body, resulting in lead poisoning. Skin contact with dust may cause irritation or sensitization, possibly leading to dermatitis.

10.3. Chronic: Excessive and repeated exposures to dust may cause::

- Allergic sensitization: skin inflammation and asthma
- Lung inflammation and damage - pneumonitis, pneumonia, bronchitis, siderosis, diffuse pulmonary fibrosis
- Nasal perforation and nasal cavity damage
- Eye inflammation
- Central nervous system damage, possibly permanent
- Kidney damage
- Liver damage
- Gout - arthritis

- Lead poisoning
- Exposed organs: respiratory tract
- Exposure routes: inhalation, ingestion

10.4. Carcinogenicity: The carcinogenicity of this solid product as a whole has not been tested. Individual components and some compounds of these elemental metals may have been associated with carcinogenicity by NTP and IARC.

Accidental release measures

10.5. Steps to be taken in Case EAF D is Released or Spilled: Shut off ignition sources. Do not touch or walk through spilled material. Compressed air should not be used to clean up spills. During cleanup, skin and eye contact and inhalation of dust should be avoided as much as possible. Provide local exhaust or dilution ventilation as required. Appropriate PPE should be worn if exposure limits are exceeded. Collect material in compatible and appropriately labeled containers. For small dry spills, place material into clean dry container with a clean shovel, and cover loosely.

Storage and Handling

10.6. Handling Precautions: Avoid breathing of and contact with dusts

Toxicological Information

10.7. Iron: Excessive exposure of eyes to airborne iron dust can cause conjunctivitis, choroiditis, and retinitis. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in development of a benign pneumoconiosis, called siderosis, which is observable via x-ray. Inhalation of excessive concentrations of iron oxide may enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens.

10.8. Zinc: High airborne concentrations of dust may cause temporary irritation of the nose and throat. Metal fume fever can be caused by inhalation of zinc oxide fume formed in air from welding or heating zinc metal. Zinc compounds have relatively low toxicity by ingestion.

10.9. Chromium: The health hazards associated with exposure to chromium are dependent upon its oxidation state. The metal form (chromium as it exists in this product) is of low toxicity.

10.10. Nickel: Nickel fumes are respiratory irritants and may cause pneumonitis. Exposure to nickel and its compounds may result in the development of a dermatitis known as “nickel itch” in sensitized individuals. The first symptom is usually itching, which occurs up to 7 days before skin eruption occurs. Nickel sensitivity, once acquired, appears to persist indefinitely. Nickel and certain nickel compounds have been listed by NTP as being reasonably anticipated to be carcinogens. IARC has listed nickel compounds within group 1 and nickel within group 2B. Nickel is not regulated as a carcinogen by OSHA.

10.11. Aluminum: Inhalation of finely divided aluminum and aluminum oxide powder has been reported as a cause of pulmonary fibrosis and lung damage.

10.12. Silicon: Elemental silicon is an inert material which appears to lack the property of causing fibrosis in lung tissue. Silicon dust has little adverse affect on lungs and does not appear to produce significant organic disease or toxic effects when exposures are below the permissible exposure limit. Silicon may cause chronic respiratory effects.

10.13. Manganese: Chronic manganese poisoning may result from prolonged inhalation of manganese dust and fumes. The central nervous system is the chief site of damage from the disease, which may result permanent disability. Symptoms include languor, sleepiness, weakness, emotional disturbances, spastic gait, recurring leg cramps, and paralysis.

10.14. Copper: Industrial exposure to copper fumes, dusts, or mists may result in metal fume fever with atrophic changes in nasal mucous membranes. Chronic copper poisoning results in Wilson's Disease, characterized by a hepatic cirrhosis, brain damage, demyelination, renal disease, and copper deposition in the cornea.

Protection and Control

Proposed Measures for Prevention and Control

10.15. Proposed preventive measures are of paramount importance and must be enforced by. Gulf Global Dust Co., Ltd., to minimize the risk of above mentioned metals intoxication. A list of activities that should be observed in the plant environment in order to prevent the lead exposed workers from suffering adverse effects of lead contamination. The most important proposed measures are:

- Eye contact: rinse immediately with plenty of water and seek medical advice. In case of mechanical abrasions and cuts, seek medical attention;
- Skin contact: Wash immediately with soap and water and seek medical care. Cuts or abrasions should be treated promptly with thorough cleansing of the affected area.
- Ingestion: If ingestion does occur, seek immediate medical attention. Do not induce vomiting unless directed to do so by medical personnel.
- Inhalation: Immediately remove the affected person to fresh air, make breathing. Seek medical attention immediately.
- Dust accumulation from this product can present an explosion hazard in the presence of an ignition source. Coatings and oils contained in the

product may enhance flammability. Keeping this product wet may reduce the risk of ignition to a minimum limit.

- Fire or thermal processing may release products of hydrocarbon decomposition and metal fumes
- Use appropriate fire fighting means
- Fire fighters should wear full-face, self contained breathing apparatus and impervious protective clothing. Fire fighters should avoid inhaling any combustion products;
- Avoid discharge into drains, water courses or onto the ground.
- Dust should be swept up and placed in suitable container;
- Operator must consider prevent contact of hazardous material as a possible source of environmental and human contamination.
- Work environment must be maintained in accordance with local authority requirements.
- Don’t eat or smoke within the work premises.
- All staff must attend the periodical educational and training programs
- Use proper personal protective equipment always in the workplace.
- Perform periodic medical examinations once a year for workers exposed to lead.

Occupational Health and Safety:

10.16. The operations required for recycling arc furnace dust present several potential risks on occupational heath and safety. Some of these risks such as emissions, fumes (sulfur dioxide) and the use fuels are industry specific. Others are general in nature and range from trip hazards, handling and storage of EAF.D moving machinery (e.g. silo trucks, forklifts etc.) and non-compliance of personal protective equipment.

10.17. Employers and supervisors are responsible for implementing all reasonable precautions to protect the health and safety of workers. Preventive and protective measures should be introduced according to the following order of priority:

- Eliminating the use of extremely hazardous materials by substituting them with less hazardous ones;
- Controlling the hazard at its source through use of engineering controls and best available technologies (BAT);
- Minimizing the hazard through administrative or institutional control measures; and
- Providing appropriate personal protective equipment

10.18. Occupational Health and Safety from the construction and operational phase include but not necessarily limited to the following:

- Physical Hazards: Trips, Slips and Falls, Rotating Equipment, Hot Surface, Heat, Elevated Platforms and Heights, Falling Objects, Poor Housekeeping, Vehicle accidents, etc;
- Chemical hazards: Exposure to chemicals, fuels, etc;
- Biological Hazards: Septic Tank Wastes, Allergies, Unhygienic Conditions, etc; and
- Other Hazards: Physiological Stress, Heat Stress, Noise, Ergonomic Hazards, etc.

10.19. The most significant community health and safety hazards associated with such manufacturing facilities include the threat from major accidents related to potential fires and explosions or accidental releases of raw materials or finished products during transportation outside the processing facility.

10.20. Operators may also be exposed to noise from internal transport, Kiln, fans, various steam and air leaks, and so on. Others may include inhalation of fumes due to poor ventilation.

10.21. All workers should be trained in occupational health and safety and applicable protocols. All workers will be provided with personal protective equipment (PPE). PPE provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems. A summary of PPE are presented in Table 10.4.

Table 10.4 summary for personal Protective Equipment

Objective	Workplace Hazard	Suggested PPE
Eye and face protection	Flying particles, liquid chemicals, gasses or vapors, light radiation	Safety Glasses with side-shields, protective shades, etc.
Head Protection	Falling objects, inadequate height clearance and overhead power cords	Plastic Helmets with top and side impact protection.
Hearing Protection	Noise, Ultra-sound	Hearing protectors (ear plugs or ear muffs).
Foot Protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand Protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, insulating materials, etc.
Respiratory Protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

10.22. To reduce the risks to personnel responding to emergencies situations, Global Steel Dust Gulf shall develop, implement and continuously review a Health and Safety Program (HSP). The HSP will contain the identification of all potential health and safety hazards associated with the project, all the procedures and equipment which are appropriate to deal with the identified risks and hazards; the identifications of all responsibilities related to the implementation of the plan and the emergency response procedures.

10.23. The working environment should be monitored for occupational hazards relevant to GSDG specific operational conditions. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and dangerous occurrences and accidents.

10.24. To determine the effectiveness of Health and Safety measures, GSDG should be regularly audited to collect information concerning the number of work accidents, the quality of response to emergency situations, safe operating practices, etc., which will be analyzed and used to review the HSP.

10.25. Plant health and safety rules shall be established and enforced. They shall include:

- Annual medical examination for the workers who may be exposed to lead,
- Periodic medical hearing checks should be performed on workers exposed to continual exposure to high noise levels.

Environment, Health and Safety Audits

10.26. Environment, health and safety process should be performed annually to assess the environment and human safety status in project.

11. TRAINING REQUIREMENTS

11.1. As a part of proposed project, the plant employees training on general environmental awareness is necessary to be furnish. The Heath Safety and Environment (HSE) Manager shall provide this training, making construction staff and GSDG. site staff aware of general environmental issues, site specific issues as well as general health and safety procedures in order to mitigate possible injuries as part of the proposed project activities.

11.2. such training should be applied on all employees during the project implementation which include but not limited to:

- General environmental awareness
- Occupational noise
- Leaking and spilling awareness and emergency response
- General understanding about lead exposure.

11.3. Heath Safety and Environment (HSE) Manager should be responsible to train GSDG staffs in firefighting, safety and fire drills, fire prevention, responding to environmental incidents, spills and other relevant HSE matters or it can be done by an accredited third party HSE training facility.

Training:

11.4. All staff shall be made aware of the regulatory and statutory implications of the authorization for the process and their work activities.

11.5. Training shall be given to all staff involved in process operation and this should include the environmental implications of their work and the procedures for dealing with incidents. There should be records of the training given to staff.

11.6. It is planned that all personnel likely to be involved in the project shall undergo a basic training program prior to performing assigned work at the plant. The training shall include the following:

- Detailed briefing on the manufacturing process, including impacts, hazards;
- Familiarization with the fire protection systems and PPE;
- General safety training concerning lead and its hazards, general protective equipment, base features of emergency plan and first aid; and
- Training in pollution control technology;

11.7. A "basic training course" shall be conducted to make plant's operators familiar with the plant main equipment and to teach the process fundamentals with the use of standard training aids.

11.8. An “advanced process training course" for the key personnel (shift supervisors, plant management) shall be also held.

11.9. For first aid personnel, specific training shall be provided concerning hazards of the plant, specific hazards related to acids and lead, precautions and first aid, monitoring program.

11.10. The plant operation manual shall be used as a training tool. A training file should be established for each employee, listing the subject and the date trained. Proper records of all training and audits shall be maintained.

12. CONCLUSIONS AND RECOMMENDATIONS

12.1. This EIA was carried out during the project proposal stage for GSD Gulf Ltd. Electric Arc Furnace Dust (EAF.D) Recycle Plant, Dammam, Saudi Arabia. The EIA was carried out in line with and the requirements of the PME and therefore involved review of project specifications, regulatory requirements, determining existing environmental conditions through field surveys, identification and evaluation of impacts and providing recommendations for mitigation measures. Based on the assessment, the conclusions of this EIA study are as follows:

(a) Air Quality: The impacts on air quality are expected in the construction phase due to dust and vehicular exhaust emissions. However, as the construction activities are temporary the impacts are manageable with provision of adequate mitigation and control measures. Mitigation measures are provided in section 7 for dust control. The air dispersion modelling results indicate that PME Air Quality Standards are unlikely to be exceeded as a result of emissions from the proposed plant. Thus impact on air quality is not expected to occur in operation phase.

(b) Soil and Groundwater: The impacts on soils and groundwater are expected in the construction as well as operation phases. The nature of construction activities and use of equipment and machinery may impact the soil profile in the project areas. However, adherence to appropriate mitigation measures as described in section 7 at project site are expected to minimize impacts to soil and groundwater during the construction and operation phases;

(c) Flora and Fauna: Displacement of flora and fauna and loss of their habitat in the project areas from construction phase activities are not considered significant as vegetation in the area are insignificant and also there is no presence of any endangered or threatened species. However, all project activities should be limited to the approved passage to ensure any impact is localized. Operations phase impacts on flora and fauna are also not expected.

(d) Noise: Noise is expected in both the construction and operation phases of the project. However, the adherence to appropriate mitigation measures as described in section 7 are expected to minimize impacts; and

(e) Health and Safety: Various health and safety hazards exist in any construction effort. The CEMP should broadly identify the various hazards and risk minimization and control measures including the use of PPE, medical surveillance, audits and reviews. Typical hazards for which controls must be implemented include but not necessarily limited to physical hazards, chemical hazards, biological hazards and other hazards.

12.2. Before initiating any construction activities, a construction environmental management plan should be developed to challenge and alleviate the environmental impacts or monitoring and control of increasing the frequency generation dust during the construction phase,

12.3. A detailed dispersion modeling assessment of the potential impact of the proposed stack has been carried out using the AERMOD model. The results indicate that the PME Air Quality Standards are unlikely to be exceeded as a result of emissions from the proposed plant.

12.4. The Waelz kiln technology features are summarized below:

- No liquid effluents or process wastewater released from the plant since all the water used in production and utility areas is completely recycled inside the plant. The Waelz Kiln system transforms the EAF.D into Zinc Oxide and Iron oxide.
- Due to the high lime (CaO) content in the EAF.D most of the fed-in sulfur is bound in the solid matter of the kiln and becomes part of the Waelz Iron Product mainly as CaS/CaSO4 and FeS. Partly, the sulfur reacts with lead and forms volatizing PbS, which is sublimated and oxidized to PbSO4. Only a minor part leaves the kiln as gaseous SO2 with the flue gas. Most of that is adsorbed by the fine ZnO particles on the surface of the bags in the bag house filters. The capture of sulfur in the WIP and the adsorption of gaseous SO2 by ZnO reduces the atmospheric emission to maximum 50

mg/m3 (standard, dry) even on high sulfur feed and to normally less than 30 mg/m3.

- The dioxin treatment / reduction has been successfully applied in Waelz plant and is a proven. The dioxin emission is guaranteed to less than 0.1 ng/m3 I-Teq (standard, dry).
- The furans PCDD/F concentrations in the feed materials are almost completely destroyed thermally in the basic operating mode and do not have a significant influence on the raw gas composition.
- Use of activated carbon for dioxin reduction, thereby Hg can be also adsorbed in the pores and captured. Therefore, the gaseous emission of Hg is less than 20 µg/m3 (standard, dry).
- Flue dust recycling recovery: the flue dust captured from bag houses are fed back periodically to the Waelz kiln system for the metal recovery. The recycling of captured dusts not only reduces wastes generation but as well improves yield of zinc oxide in the recycling operations; and.
- Fumes are continuously drawn off in a closed duct system and conveyed through a fumes settling chamber to a bag house filter where lead, SO2, Nox, Dioxins and other particulate are mechanically removed by fabric filters and collected through conveyor system to be recycled.

12.5. The health and safety manager shall be responsible for GSDG member's staff Training on general environmental issues and protection means in site. With proper adoption of Environmental Management Plan (EMP) established by EIA report, the overall environmental performance is in the compliance with PME regulations. GSDG should commit to continuously improve its plant operations and environmental performance in line with prevailing environmental legislation.

12.6. GGSD has to set a comprehensive emergency response plan to be used in cases a fire or a major spill or other dangerous accidents occurring in or near the Plant facilities. The plans are designed to prepare employees and local emergency response personnel to handle emergencies involving facilities and protect the public. Communication and cooperation with local organizations are key components of the emergency response plans, and the feedback from these interactions is used in the development and revision of these plans.

12.7. This EIA has concluded that significant environmental impacts occur during the construction and operation phases of the project and can be mitigated and controlled by implementing various recommendations provided in this report.

13. Appendix 1

List of terms used in the Impact Assessment Methodology

Significance

HIGH Exceedance of International or National Legislative Value or Non Compliance with PME Standards – for example an exceedance in the ambient air quality limits set by the PME.

MODERATE Change in existing environmental conditions of 10% of an environmental parameter acting on a sensitive receptor.

LOW Change in existing environmental conditions of 5% of environmental parameter acting on a sensitive receptor

Residual Significance:

Any effect which remains at a significant level even after the implementation of mitigation.

Sensitivity: measure of the degree of tolerance of a Valued Environmental Receptor (VER) to change

Site Value:

A measure of the value of the VER based on geographical context ranging from International to Very Local. For example in archaeology a site listed by UNESCO such as Madein Salah would be of International Value, whilst a small common pottery shard found on the surface would be of very local value (where archaeology is related).

Magnitude of Impact:

The impact Magnitude will where possible be quantified but uses a relative scale from Major to Minor and is based on professional judgment if actual values are unknown.