Executive Summary

Background

Egyptian Indian Polyester Company is planning to establish a facility for manufacturing PET in Damietta Port industrial area in Damietta Governorate. The company is a joint venture between South Asian Petrochem Ltd., India (SAPL), Egyptian Petrochemicals Holding Co. (ECHEM) and Engineering for the Petroleum and Process Industry (ENPPI). The share holding pattern of the new joint venture company will be: SAPL – 70% equity, ECHEM – 23% equity and ENPPI – 7% equity.

The facility would produce 315 000 MTA of bottle grade PET (Polyethylene Terephthalate) resin. About 80% of the product is intended for export through Damietta port while about 20% would cover the needs for the local market, which currently imported.

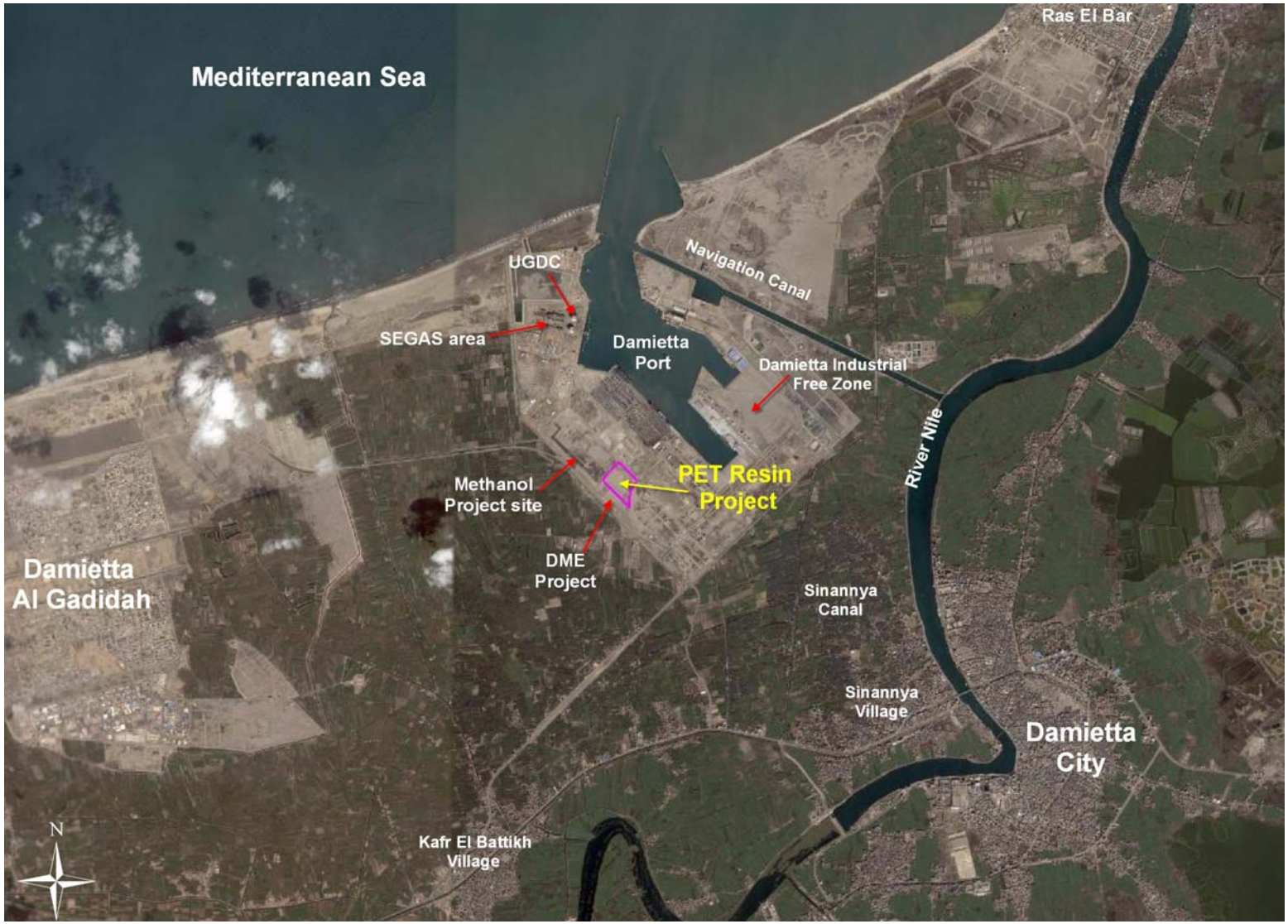
Within the framework of Law 4/1994 and its executive ER, the company assigned the Environics the consultancy firm to develop an environmental and social impact assessment study for the proposed project.

The study covers the different aspects related to the construction and operation phases encompassing:

- The PET production process within the facility premises
- The (Effluent Treatment Plant) ETP plant and the discharge of treated wastewater
- The raw material/product storage

Project Location

The proposed project site is located at the southwestern end of Damietta port within the plot that was allocated in 2004 for ECEHM for construction of facilities of basic and intermediate petrochemical products (Mubarak Complex for Natural Gas and Petrochemicals). The Egyptian Methanol project (EMethanex) is located northwest of the PET site, to the southwest an empty land area, not yet designated for any industrial activities, owned by ECHEM.



The Location and Surrounding Area of PET Project

Process Description

The proposed PET facility uses Purified Terephthalic Acid (PTA), Monoethylene Glycol (MEG) and Purified Isophthalic Acid (PIA) to produce bottle grade Polyethylene Terephthalate Polymer (PET). Other raw materials include DEG (Diethylene glycol) catalysts and additives. The production process is performed in two steps, namely producing amorphous polymers followed by production of the final crystalline resin. The production reactions encompass estrification and polycondensation reactions followed by solid state polycondensation to produce a polymer with the required viscosity. The production process is described in detail in the following sections.

- **Production of amorphous polymer**

  The process stages include:

  - ***Paste preparation***

    The raw materials, PTA and PIA, in solid form, are conveyed into the paste preparation tank. MEG and DEG, in liquid form, and the catalyst powder form are mixed with PTA and PIA in the paste preparation tank. The prepared paste is fed directly to the estrification reactor.

  - ***The Estrification reaction***

    In this stage, estrification reaction takes between MEG, PTA and PIA in presence of a catalyst to produce an estrification product. As result of the estrification reaction, water is generated as by-product in addition to the excess MEG. The MEG is recycled to the estrification reactors and water, contaminated with organic constituents, is transferred to the Effluent Treatment Plant (ETP).

  - ***Pre-Polycondensation reaction***

    The polycondenstaion reaction takes place in vacuum, and high temperature. MEG is condensed and recycled back for paste making. The resulting pre-polymer melt is transferred to the polycondenstaion reactors via pre-polymer gear pumps

  - ***Final Polycondensation***

    The low molecular PET is polycondensed to high molecular PET. The reaction takes place under stirring, increased vacuum condition and elevated temperatures of about 280^0C. The desired degree of polymerization of the melt and thus its viscosity is achieved through this reaction.

  - ***Chip production***

    The final polymer melt from the polycondensation stage, with higher molecular weight is filtered and transferred to the chip production unit where the molten polymer is cooled down by means of a loop of demineralized water then cut into chips of uniform size. The resulting amorphous PET chips are subsequently dried and screened for removing over-size and fines then sent to intermediate storage silos prior to being fed to the SSP unit. The used demineralized water is filtered, cooled and recycled to an underwater cutter.

- **Production of crystalline PET resin**

  This process involves implementing solid state polymerization (SSP) to upgrade the amorphous PET produced from the polycondensation stage to high quality bottle grade resin. The process is typically conducted at high temperatures and under inert-gas conditions, such as nitrogen to prevent degradation of the polymer at high temperatures. The SSP stage includes:

  - ***Crystallization (pre-crystallization)***

    In the precrystalizer the adsorbed moisture on chips is removed by passing hot nitrogen counter currently. The amorphous chips typically have PET dust on their surface, thus the pre-crystallizer also performs a de-dusting operation to remove the fine PET particulates from the chips. The dust generated during fluidization process is separated by cyclone separators.

  - ***Annealing (crystallization)***

    This is similar to precrystallization where the chips are heated up to the required temperature in an inert environment, hot nitrogen that prevents thermal and oxidative degradation of the chips. Nitrogen flows countercurrent to the flow of chips to remove acetaldehyde and other volatile organic compounds released during heating and crystallization.

  - ***SSP reaction***

    This is carried out in the SSP reactor where sufficient residence time, about 10 -12 hours, is given to polymer in the reactor to build up the polymer chain. This is achieved by passing hot N_2 counter currently for driving out reaction byproducts such as FCs and aldehydes. The product from SSP Reactor is taken to de-duster for cooling, sieved for removing dust before conveying to storage silos.

  - ***Nitrogen Purification System***

    As discussed above, the nitrogen, providing inert conditions, is contaminated with volatile organic hydrocarbons such an acetaldehyde, MEG, oligomer dust and water. The circulated gas needs to be purified to maintain reaction efficiency and minimize nitrogen make up. The nitrogen purification system consists of catalytic oxidation reaction where the contaminants are oxidized to carbon dioxide and water. The wet nitrogen is dried by adsorption of water in drying beds.

  - ***Packaging***

    The final product is packaged in preparation for export or distribution in the local market

Utilities

The PET plant uses various utility units, which serve either to provide the polycondensation and SSP plants with the required utilities or to handle/treat process effluents.

- **Water Utilities**
  The water requirement for the plant is about 500m^3/day for industrial and domestic activities. Part of this water (about 250 m^3/day) will be provided by New Damietta City Urbanization Authority, which provides potable water. The remaining quantity (250m^3/day) is available through recycling of the reaction water generated at the polycondensation phase.

- **Wastewater streams treatment**
  The facility uses Anaerobic-Aerobic-Bio-Carbon (AABC) effluent treatment process. The treated water will be used as make-up for cooling tower. The sludge generated from the ETP is recycled as digested sludge for wastewater treatment.

- **The HTM System/steam generation**
  The facility uses high and low pressure steam for filter cleaning and off gases stripping. The different steam requirements are generated through the heat exchange in the HTM heaters. HTM heat pumps are used to circulate the HTM (Therminol 66) in a closed system to the different heaters.

- **Electricity**
  The electricity requirements will be 5.5 MW. The company will also install a standby power generator (8MW) as a 100% backup in case of power failure

- **Fuel**
  The facility uses natural gas as fuel in the HTM system (about 3000m^3/hr). However, in case of natural gas shortage the company will use diesel fuel as alternative fuel.

Outputs, Wastes and Emissions

- ***Air Emissions***
  - HTM stack
  - Catalyst preparation
  - PTA/PIA handling
  - PET packaging

- ***Wastewater and Liquid Wastes***
  - **Domestic Wastewater**

    About 20m^3/day. The generated domestic wastewater will be discharged into the Damietta Port west sewage station. During the construction phase, a construction camp is to be established to accommodate about 150 people. The generated domestic wastewater from labour activities will be discharged into the sewage network of the port.

  - **Industrial Wastewater**

    a) Process wastewater

    Process wastewater containing organic constituents is generated from the polycondensation plant, with a total flow rate of about 250m^3/day.

    b) Wastewater from utilities

    Utilities generating wastewater including relatively high concentration of TDS:

    - Cooling tower blow down
    - Chiller blow down
    - Backwash effluent from DM system
    - Softener backwash

    The process water and filter cleaning water will be treated in the ETP and reused as makeup for the cooling tower. Wastewater streams from utilities will be used for irrigation and landscaping within the facility premises.

- ***Solid and Hazardous Waste***
  - **Hazardous Wastes**

    These include:
    - Polypropylene filters used in the catalyst filtration section
    - Sludge containing traces of heavy metals generated form filter cleaning process
    - Spent catalyst containing platinum used in SSP reactors

  - **Non-Hazardous Waste**

    Include the following:

    - Off-spec packaging bags
    - Empty raw material bags
    - Domestic wastes (food, glass, plastics, cardboard, etc.).

Environmental and Social Impact Assessment

Environmental Baseline

The environmental baseline for the project area was investigated through desk studies and field surveys in the project area and it's surrounding potentially influenced environment. The surveys included investigating the water quality and noise level. The environmental components studied include the physical, biological and socio-economic environment.

Physical Environment

- **Climate**

  The coastal climate of Damietta Governorate is "Mediterranean semi-arid"; characterized by mild winters with occasional rain and hot summers.

- **Topography**

  The overall area of the proposed project maybe considered flat. The wider Nile Delta is relatively flat and low lying, raised only slightly above sea level and bisected by the River Nile's distributaries and the dozens of irrigation and drainage channels that honeycomb the delta region.

- **Soil characteristics**

  Soil generally is a cohessionless soil deposits (Yellowish grey / grey, medium dense to dense fine sand containing little some fines (silt & clay) and trace of crushed shells.

- **Groundwater Resources**

  The groundwater in the area is generally saline and strongly affected by seawater intrusion. With this in mind, groundwater is not used for any drinking or other purposes.

- **Air Quality and Noise**

  Baseline air quality and noise monitoring was carried out at four locations within and surrounding the proposed PET location. The measured air quality parameters were found within acceptable limits in accordance to the executive regulations 338/1995 of Law 4/94 as well as the IFC maximum limits for ambient air quality.
  Regarding ambient noise levels, results indicate that all baseline noise measurements were below the allowable limits of the amended executive regulations of Law 4/94 as well as those of the IFC.

Biological Environment

The proposed project lies within Damietta port, which has mostly been constructed. Since the port is already built, the specific project location is mostly void of fauna and flora.

Social and Economic baseline

The proposed project is located in Damietta Port. 75% of the port area is located in Markaz Damietta and the remaining 25% of the port is located in Kafr Saad. The

closest residential areas to the project location are Al Sannania (part of Markaz Damietta) village and Kafr Al Batikh city (part of Markaz Kafr Saad), which will provide the project with the necessary infrastructure requirements. Moreover, the project will provide employment during construction and operation, contributing to improving the socio-economic status in the area.

The Environmental And Social Impact Assessment

Potential impacts of the proposed project are identified based on a modification of the Leopold matrix. In addition scoping meetings were conducted with key stakeholder in the area to introduce the project and incorporate their comments within the ESIA.

- **Positive impacts**

  The project will provide more than 800 direct job opportunities during construction and about 400 direct job opportunities during operation, in addition to significantly more indirect job opportunities during construction and operation. The project will be an addition to the local and national economy. The exported product, which amounts to about 252000 mta, will add about USD 353 million to the national economy. Other benefits include the socio-economic development of Damietta area. In addition, the project will contribute to the community services in the training and health areas.

- **Irrelevant impacts**

  The different activities related to PET production will have no contact with marine water or marine life since the company will not discharge any of generated waste streams (liquid or solid) into the marine environment. The generated wastewater will be recycled within the facility with minimal quantity discharged into the public sewer network.

- **Potential Negative Impacts**

  Potentially significant impacts and their mitigation measures are summarized in the following tables:

Table 1: potential impacts during construction

Potential impacts	Mitigation measures	Environmental management plan	Environmental monitoring
Air quality - Dust and emissions from construction activities	- Dust suppression measures at the site - Maintaining machinery and vehicles in good working conditions - Frequent inspection of all construction equipment	- Construct a fence around the site - Establish an on-site office to manage the construction activities. - Provide personal protective equipment (PPE) - Properly label stockpiled material, provide proper access control measures to prevent accidental exposure, and provide personal protective equipment and first-aid kits. - Install fire extinguishers in designated places throughout the site. - Implement all applicable occupational health and safety measures stipulated in the Egyptian labour law 12/2003 - Waste from temporary construction facilities will be disposed of in an appropriate manner.	• Air quality • Noise levels • Workplace environment
Noise during construction	- Ensure that workers use personal protective equipment (PPE) - Periodic maintenance for noise generating equipment		
Occupational health	Implementation of proper occupational health measures and provide workers with the necessary PPEs		

Potential impacts	Mitigation measures	Environmental management plan	Environmental monitoring
Social impacts - Potential tensions can arise between the two groups (locals and non-locals) in terms of competition for employment - Cultural tensions as result from foreign construction workers	- The contractor will be required to use local employees as much as possible - The foreign workers will be instructed to respect the local culture		

Table 2: potential impacts during operation

Potential impacts	Mitigation measures	Environmental management plan	Environmental monitoring
Air quality - Emissions from burning of natural gas in the HTM heaters - Dust emissions in workplace from material handling	- Use of NG fuel in HTM heaters - Burn off-gases with NG - Control fuel/air ratio to reduce CO formation - Bag filters are installed to prevent dust emissions during PTA/PIA charging - Install Cyclones for collection of dust in SSP - Mechanical seals for all transfer pumps - Installation of automatic bagging systems for the products	- Good house keeping measures - Periodic maintenance - Spill prevention plans - Solid and hazardous waste management plans - Firefighting plans - Employees training and awareness - Contractors and supplies awareness - Health and safety	- Air quality - Noise levels - Self monitoring (stacks and ETP) - Equipment and machinery maintenance programs - Inspection of emergency equipment - PPEs
Noise from compressors, blowers and cutters	- Machinery and equipment designed according to standard specifications - Acoustic enclosures are installed for casings of all noise generating equipment - Provide workers with PPEs		
Workplace Health and Safety potential impacts from noise and heat stress during operation	- The use of hearing protection should be enforced actively in the facility. - Periodic medical hearing checks should be performed on workers potentially exposed to high noise levels.		

Potential impacts	Mitigation measures	Environmental management plan	Environmental monitoring
Impact on public health	- Impacts on public health are unlikely to occur due to the fact that the nearest residential area to the site is at about 3 km away. - Dispersion modeling of atmospheric emissions was conducted for the PET facility, in addition the cumulative impact of the PET emissions and the neighboring companies' emissions indicated that the impact on the surrounding community is insignificant		
Potential pool fire risk from spills of MEG The hazardous scenario identified is the leak of mono ethylene glycol, which is stored in large quantities inside the facility that when subject to random but major source of ignition may give rise to a pool fire	Based on the QRA results, it is evident that there is virtually no off-site risk to the surrounding population. The risk to the onsite population is extremely low and can be further mitigated with the implementation of proper mitigation measures.		