FACT FINDING VISIT TO SPAIN AND PORTUGAL

1 INTRODUCTION

Afro Fishing (Pty) Ltd (AF) wishes to construct a fishmeal production plant on the premises adjacent to their current operations in the Mossel Bay harbour precinct. The premises used to be operated by I&J for fish processing purposes. Although it is a working, commercial harbour, it is in close proximity to residential and business premises to the east and south of AF's current site.

This close proximity, together with the negative impressions that people have of fishmeal plants as a result of their experiences with South Cape Fishmeal in Mossdustria, will complicate the process of obtaining environmental authorisation for the planned process. The only possible way in which this can possibly be achieved is by applying the best available fishmeal processing and odour abatement technology that is available on the market today.

The USEPA's AP-42 states "*Afterburners are most effective, providing virtually 100 percent odor control*" and base their findings on research work dons in the late 1980s and early 1990s. It supports the general acceptance that waste organic gases are destroyed at high temperatures by breaking the compounds down to their basic components, e.g. CO_2, H_2O, NO, etc.

Currently, the best available odour abatement technology used in the world today follows the high-temperature approach in the form of thermal oxidisers of which regenerative thermal oxidation (RTO) is one method. RTO has been applied very successfully in various odour reduction application, notably in fishmeal production plants where it is used to destroy the two principle odour compounds, i.e. trimethylamine (TMA) and hydrogen sulphide (H_2S). The same technology has also been applied in other applications where odorous emissions are a nuisance, e.g. coffee production.

Unfortunately no RTO process is in operation in South Africa with the result that it is not possible to inspect such a plant while in operation. As a result AF arranged for visits to two fishmeal plants where RTO technology is in use. These are:

Harinas de Andalucia in Tahivilla in Spain

Narciso Dias & Filos in Peniche, Portugal

The fact finding team (the team) consisted of the following people:

-- Deon van Zyl, CEO of AF

-- Melissa MacKay, environmental consultant for AF at Cape AEPrac

-- Chris Albertyn, Director if Lethabo Air Quality Specialists (LAQS) and air quality consultant to AF

-- Nickey le Roux, associate editor of The Advertiser in Mossel Bay and a concerned citizen

This report gives LAQS's opinion of the visits to the two plants. While visiting the plants, LAQS focused on the application and operation of the technology, as well as impact of odorous emissions from the processes.

2 AFRO FISHING'S PROCESS

The process planned by Afro Fishing will consist of the following steps:

Fish delivery:

Freshly harvested fish will be delivered by boat within 24 hours of being caught. The fish will be kept chilled while on board. The temperature of the fish currently delivered for canning purposes (human consumption) is measured as an indication of the freshness prior to the fish being off-loaded. Should the temperature exceed the minimum level it is rejected and not off-loaded.

Afro Fishing will use a similar approach in accepting fish for the production of fishmeal and will reject batches based on the landed temperature of the fish.

Once accepted, the fish load will be pumped into stainless steel tanks located on-land after separating the cooling water. The total capacity of the tanks is 600 m3, i.e. about 600 tons. Once transferred to the tank, fish will be pumped directly to a cooker on a continuous basis, thus minimising the time between catching and processing of the fish.

Waste materials from the canning process will be pumped to the cooker on a continuous basis. As the fish processed in the canning plant is either fresh or frozen, the waste materials can be regarded as fresh as well and will not generate excessive odours.

Cooking:

The fresh fish will then be pumped from the storage tanks into the cooker feed hopper. If required, the fish will be mashed and metal will be removed using electromagnets. The minimum cooking capacity will be no more than 1000 tons per day. Cooker heating will be by inner rotor and outer jacket steam application. Cookers will be designed for 6 bar steam and able to cook fish to a maximum temperature of 90-95 °C. The cooking time depends on the steam pressure, the speed of rotation and the level that the cooker is filled. The average cooking time to achieve a temperature of 80 °C is about 20 minutes. During the cooking of the fish the fish oil is liberated together with water soluble protein. The cooked fish will exit the cooker into a dewatering conveyor. The dewatering screens in this conveyor will remove the free liquid from the solids. This liquid is tanked and pumped to the decanters.

Pressing:

The wet solids will then be conveyed into a press. The press consist of two rotary screws that compress the feed thereby removing the liquid. The press cake that exits the press has an average of 50% water content. The liquid will be pumped into the decanter feed tank.

Solid – Liquid Separation:

The liquid from the press and the dewatering screen will be put through a decanter to separate the suspended solids from the liquid phase. These solids (grax) will be added to the solids from the press. The liquid along with oil will be pumped to the tanks feeding the centrifugal separators. The liquid will be centrifuged in a liquid-liquid centrifuge. The water with approximately 10% solids content will be removed from the oil and stored in a stick water tank. The oil will be polished (purified) with hot water in another liquid-liquid centrifuge and pumped into oil storage tanks. The stick water will be pumped to water evaporation plant.

Water Processing:

The blood-water from the fish storage tanks will be pumped from drainage sumps to a steel tank and cooked. This blood-water is normally combined with the cooker feed and worked as expeditiously as possible. The stick-water resulting from the separation processes therefore consists of valuable water soluble proteins. This will be concentrated in falling film waste heat evaporators. The stick-water will be concentrated from a solids content of 10% to approximately 38% and the resultant concentrate added back to the press cake prior to drying. A double or triple effect falling film evaporator will be installed which will use the waste heat from the steam dryers to evaporate the water at low temperatures and under vacuum.

Steam Drying:

The grax from the decanters and the press cake from the presses will be conveyed via screw conveyors to the steam dryers. The concentrated process water from the evaporation plant will be mixed in with the press cake. This mixture will be dried to a moisture content below 10% in the indirect steam driers. The dryers will apply outer jacket heating plus internal heating discs and designed for steam pressures of 6 to 10 bar.

Odour control:

Up to this point all process steps can be regarded as "wet" steps from where odorous emissions may occur. All odorous vapours will be extracted and treated in a regenerative thermal oxidiser (RTO) which is described in detail in Section 5.2 below.

Cooling, milling and bagging:

Fishmeal coolers located in a separate enclosed area will be used to cool down the fishmeal to room temperature using air as cooling medium. The cooling air will be passed through a seawater scrubber to remove any particulate matter than may be entrained during the cooling stage.

Grinders equipped with electromagnets will be used to produce a fine fish meal free of metal. Rolling sieves will remove any coarse material and the final product bagged by means of automatic packing. Bulk bags and 50 kg bagging capability will be catered for. Anti-oxidant dosing, using the chemical Ethoxyquin, will be added to the fishmeal to stabilize the finished product and prevent the release of odours from the final product.

The grinding and bagging steps may result in the release of particulate matter into the area and an extraction system will extract air from this area for treatment in the sweater scrubber. The scrubber will be designed to deal with the combined volume of air.

As the particulate matter that will be collected in the scrubber consists of high-protein materials and not harmful to aquatic life, it will be returned to the sea within the limitations of Afro Fishing's coastal discharge permit.

Steam generation:

Two boilers, fired with low-sulphur oil (LSO), will be used to generate the steam required for the fishmeal processing. Condensate will be recovered from the cookers and dryers in order to reduce water and fuel consumptions and increase boiler efficiencies.

Oil and meal Storage:

Fish oil will be stored in oil storage tanks. The fish oil will be loaded in bulk tankers and bulk containers. The fish oil will be pumped from the storage tanks through a loading pipe directly into tankers or into bladders in a shipping a container. Antioxidant is added to certain loads of oil to stabilize the product.

Fishmeal will be stored in polypropylene bags in the warehouse. Pest control and the normal quality management practices for human consumption food items will be maintained in the stores.

Boilers:

Low sulphur oil (LSO) with a sulphur content of 1.5% will be used to fire the two boilers to generate steam for the process as and when needed. Excess capacity will be provided so that the boilers never run on full capacity.

3 VISIT TO HARINAS DE ANDALUCIA (HdeA)

The plant is located approximately 3.2 km from the small village of Tahivilla and about 29 km from the coastal town of Tarifa. As a result the location cannot be regarded as geographically similar to Mossel Bay as it is located in open countryside.

The visit to the plant on 27 May 2019 was arranged through Dürr AG, a Germany-based company that supplied the equipment. Dürr's representative for the area accompanied the team to the plant. Dürr has installed RTO system at a few fishmeal plants around the world.

The visit started off with a meeting with the plant manager. The plant manager could not speak English and Dürr's representative acted as translator, although his command of Spanish is limited. As a result the information gathered during the meeting was not as comprehensive as wished for. Nevertheless, the following emerged from the discussions:

-- The plant processes essentially tuna offal from various sources in the surrounding area. As it is located in a fairly remote area, the material is transported to site by road and the material delivered is not very fresh.

-- The RTO system has been in operation for the last four years. HdeA has a service-level agreement for Dürr for the annual maintenance requirements of the installation. The main components replaced during these visits is replacement of the valve seals in the RTO unit.

-- Prior to installation of the RTO frequent odour related complaints were lodged at the company. However, no complaints have been received since the RTO technology was commissioned.

Unfortunately communication difficulties prevented the team from obtaining copies of the company's environmental authorisation documentation.

The team was not allowed to inspect the process itself because HdeA uses a fish oil polishing process which they did not want to share. The team could, however, see some of the process units through large windows.

Complete access to the plant's RTO installation was granted, though, so that the odour reduction process could be assessed in detail.

Some slight odours were detected on site. At the entrance gate a slight fishy odour was detected. On inspection it was found that these probably originated from drips from

delivery trucks that stop at the gate and weighbridge for security purposes. Some of the high humidity off-gases from the process are treated in a biofilter and this filtration system emitted a mouldy odour that could be detected a couple of metres from the filter.

No other odours could be detected on site, specifically in and around the RTO unit. As the industrial fish for AF's planned process will be delivered fresh directly from boats, there is no chance of odorous liquids escaping from a delivery vehicle. AF plans to treat all of the odorous process gases in the RTO unit and a biofilter will not be used, implying that related odours will not be present.

4 VISIT TO NARCISO DIAS & FILHOS (NDF)

The plant is located within the harbour precinct of Peniche in Portugal, i.e. in a setup very similar to AF's operations.

Figure 1 shows the general location of Peniche. Various coastal developments aimed at the tourist industry, e.g. residential properties, golf courses, etc., are located within 5 to 6 km from Peniche.

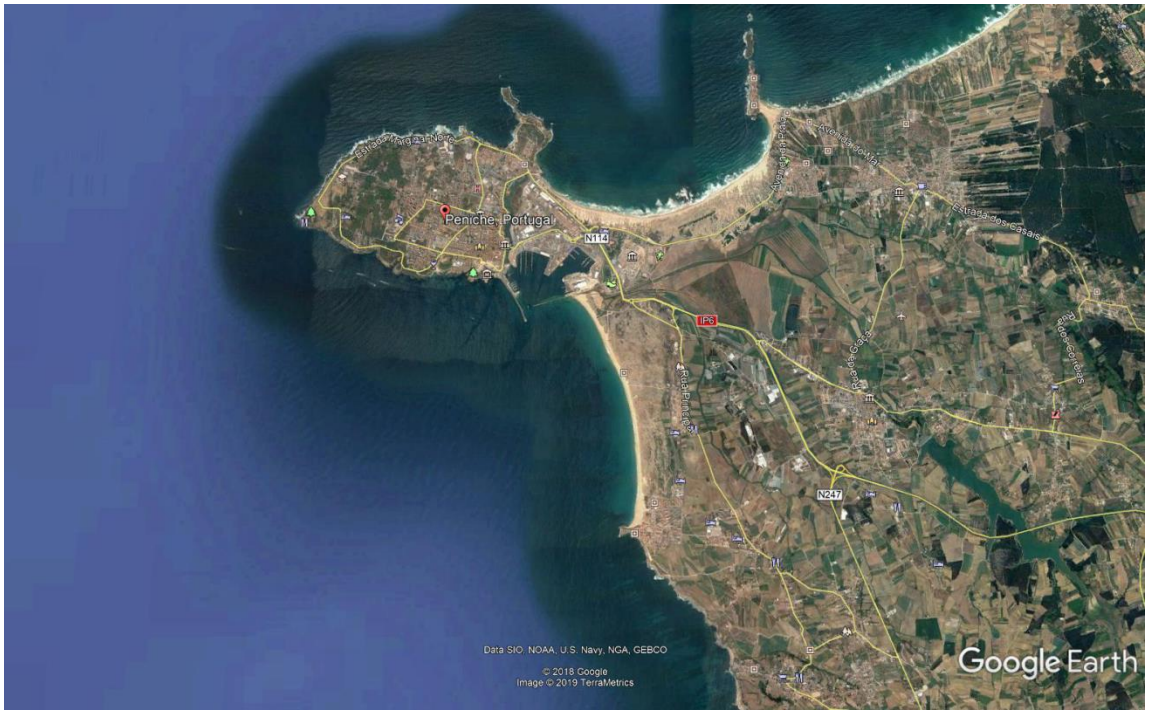

Figure 1: Peniche, Portugal

The area surrounding NDF's plant is shown in Figure 2. From this figure it can be seen that some industries (circled in blue) within the harbour precinct are located within 150 – 200 metres from ADF's operations (circled in red). Two sports fields, circled in orange, are located immediately adjacent to NDF's plant. A popular children's holiday beach activity area, circled in green, is located approximately 500 metres from site while a popular surfing area, circled in yellow, which forms part of the Billabong international surfing championship circuit is located within 1 km from the plant.

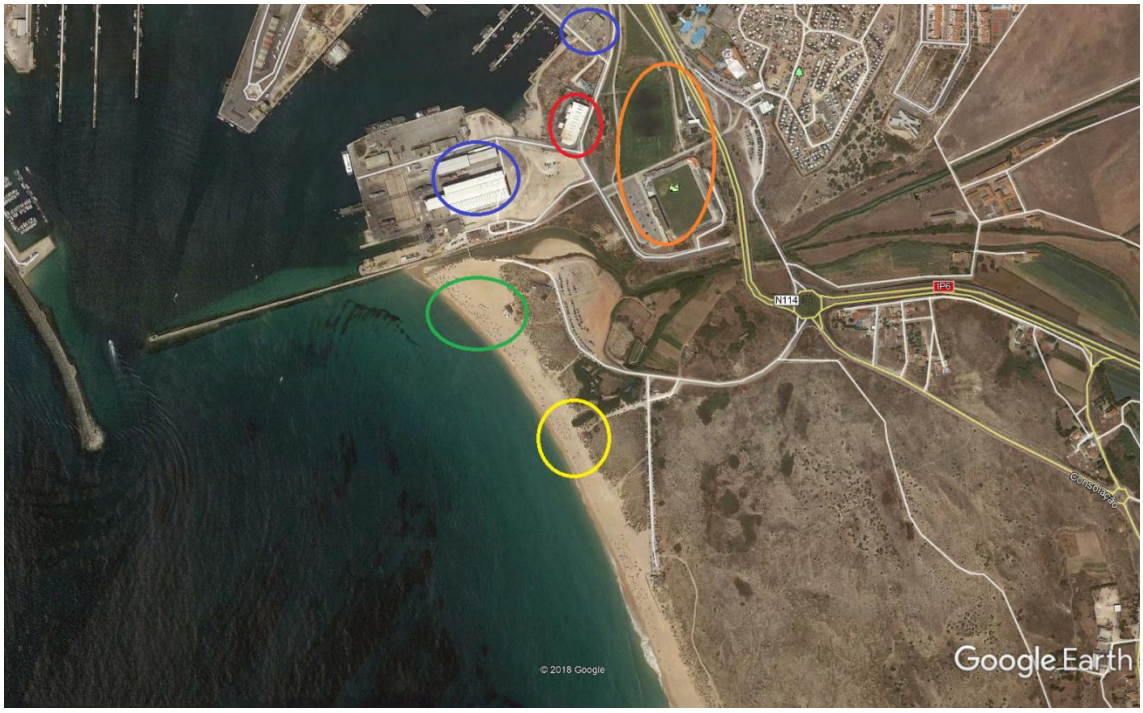

Figure 2: NDF Location relative to surrounding activities

The visit to the plant on 29 May 2019 was arranged through Haarslev Industries A/S, a Danish company that specialises in animal matter rendering equipment. A team of three Haarslev representatives accompanied the visiting party to the plant. Haarslev has supplied fishmeal production plants with RTO system at a number of locations in the world, e.g. Norway.

The visit started off with a meeting with the plant owners. Contrary to the team's experience at HdeA, communication was not a problem and the owners fully and freely responded to all queries raised by the team. On request copies of NDF's environmental licences and the results of the last round of emission measurements were provided to the team. Copies of these documents are given in the appendix to this report.

The following emerged from the meeting:

-- NDF originally operated as a red meat rendering plant, but converted to fishmeal production about 20 years ago.

-- The plant processes essentially tuna offal from various sources in the surrounding area. As it is located in a fairly remote area, the material is transported to site by road and the material delivered is not very fresh. Figure 3 shows the material received by NDF.

Figure 3: Offal received by NDF

-- The RTO system has been in operation for the last 10 years. The company has a rigid preventative maintenance program with the result that no breakdowns have occurred in the process since installation.

-- Prior to installation of the RTO so many odour related complaints were lodged that the authorities threatened NDF with closure. Complaints were lodged by local residents, holiday makers, surf competition participants, etc. However, no complaints have been received since the RTO technology was commissioned.

The team was granted full access to all parts of the plant, i.e. from the offal receiving area, through all of the process units, the RTO, the control room and the immediate area surrounding the plant.

Two distinctly different odours were detected on and around the site. These are:

-- Fish odours were detected a few hundred metres downwind of the plant. These odours were traced to an on-site effluent treatment plant. NDF is not allowed to discharge waste water into the sea and are required to do primary on-site aeration of the effluent before discharging it into the municipal sewer system, and this aeration treatment results in the generation and release of, in LAQS's opinion, TMA.

-- Meal odours, similar to those associated with pet foods, were detected on the road outside and downwind of the plant. The bagged fishmeal is left outside the building to cool and this formed the source of the odours. NDF exports its products mainly to Turkey and are not allowed to add any anti-oxidants (odour suppression materials) to the final product, hence the generation of meal odours.

No other odours could be detected anywhere inside the plant, specifically in and around the RTO unit. Liquid effluent resulting from AF's operations, essentially condensed water vapours, will be discharged to sea as part of their existing ocean discharge permit. And no on-site treatment of the effluent twill be carried out. AF plans to add anti-oxidants to their final product with the result that the fishmeal odours detected at NDF will not exist at AF's operations.

LAQS regards the visit to Peniche as extremely useful due to the very open nature of sharing information by the owners of the plant. Furthermore, the emission test results provided are equally useful as NDF's plant is similar in size to one of the two fresh fish processing lines planned by AF and can be regarded as indicative of emissions from AF's planned operations.

The team also held informal interviews with various members of the public in areas around the site, e.g. at the children's beach activity area, the surfing area, etc. The general consent was that odours were detectable from time-to-time, but at a such low frequency and concentrations that it was not regarded as a nuisance. A few people were philosophical about the odours, regarding them as an issue that goes hand-in-hand with the fishing industry which is by far the greatest employer in Peniche.

From the copies of the environmental licenses given in the appendix it can be seen that no official emission limits are stated. However, from the copy of the emission measurements it can be seen that the official emission limits for NDF's operations are:

Pollutant	Emission limit, mg/Nm3	Measured value, mg/Nm^3
Hydrogen sulphide	5	<1
Heavy metals:		
Cd + Hg + Tl	0.2	<0.02
As + Ni + Se + Te	1	1
Pt + V+ Pb + Cr+ Cu + Sb + Sn + Mn + Pd + Zn	5	2.1

Production of fishmeal resorts under category 10: Animal matter processing in terms of Section 21 of the Air Quality Act. No emission limits are defined, but the following qualifying statement applies: *Best practise measures intended to minimise or avoid offensive odours must be implemented by all installations*.

Based on LAQS's assessment of the two fishmeal plants visited in Europe, LAQS is of the opinion that the process intended by AF, i.e. enclosed process units, extraction of vapours at each process units and treatment of these vapours in a RTO system, is the best technology aimed at achieving the second part of the qualifying statement above, i.e. *avoiding offensive odours*.