Appendix C3 6a – Energy efficiency

All Industrial Chemicals plants & processes are designed to be as energy efficient as possible. The plant design and mechanical equipment specifications will be for the most energy efficient machines on the market. Also in using the DAA from permit EPR/SP3937JT, the electricity, steam, hot & cold water generated from the power generation will be used to operate the various processes detailed in Permit BJ7298IF. The power plant that is adjacent to the site, owned & operated by Industrial Power, will only have one customer, which is to be Industrial Chemicals Limited.

In using the permitted process adjacent to the site, via a Directly Associated Activity, it means that there will be less pressure on the National Grid with regards to demand for electricity. As this process will also be supplying steam but hot & cold water, there will be a reduced demand for ancillary equipment such as boilers (for steam & hot water) and chiller units. Therefore making the processes energy efficient.

Appendix C3 6b – Breakdown of Energy change

The only change to the energy consumption will be to the amount of time that processes are actually running. The energy levels currently consumed are indicative to the current levels of productions. Any increase in demand for either the current products or any future products will result in an increase in energy usage.

Process 5 – This process requires little or no energy to operate. This is due to the millscale being added to the dissolver units and the Hydrochloric acid being trickled through the millscale, dissolving the iron as it passes through. The only energy that this process used is from the use of pumps & filtering systems. There is no requirement for energy to be added to this process.

Process 6 – This process also requires little or no energy to operate. This is due to the chlorine gas being bubbled through the ferrous chloride solution and then the solution then trickled through more millscale to bring the iron level up to meet the required specification.

Process 7 – this process does require the use of energy to heat the sulphuric acid to evaporate the excess water and to also condense the steam to create chilled water. The amount of energy used, will be in direct relation to the volume of sulphuric acid that will be evaporated. The exact figures are not yet known, as the plant is not yet operational.

Process 8 – The manufacture of PolyAluminium chloride does require the use of energy, steam to create the preferred environment within the reactor to enable the reaction to go to completion. Although this is to start an exothermic reaction, the exotherm created, is not enough to allow the reaction to be completed. Therefore the reactors are subject to steam pressure to push the reaction on. As with other processes, the amount of energy used is in direct relation to the volume of product produced.

Process 9 – the manufacture of Sodium silicate is also a process that does require the use of energy to enable the reaction to take place. The reaction takes place under pressure in reactors designed to use steam to create the heat required to enable the reaction to take place.

Process 10 – the manufacture of Sodium citrate does not require excessive energy to enable the reaction to take place, as it is an exothermic reaction. The only other energy requirements that the process has, is the use of pumps.

Process 11 – the manufacture of Aluminium sulphate is an exothermic reaction and as such does not require the addition of extra energy to enable the reaction to take place. The only other use for energy is in the filtering & pumping of the product to storage vessels.

Multi Product Protocol – all products produced under this umbrella, would be process designed to use the least amount of energy as possible.

Appendix C3 6c – Climate Change Levy

Using the rules and regulations associated with the Climate Change Levy (CCL), it was deemed that Process 5, 6, 7, 8, 9, 10 & 11 do not consume enough energy to qualify for the CCL for the site, even in addition to the current volumes been consumed in the other processes, that currently operate on the site. If there were drying processes, then the site would qualify, however this is not the case with the proposed processes & products.

Appendix C3 6d – Raw Material Justification

For some of the processes detailed below, the raw materials have been determined from numerous years of manufacture at other Industrial Chemicals sites, but justification that these are the best raw materials to use is detailed as well. Also as part of the sourcing of the raw materials, Industrial Chemicals has always endeavoured to obtain its raw materials from within the boundaries of the United Kingdom. However with some products, due to the source of the product this is not possible for example the closest sources of aluminium hydrate are either Spain or Germany (as this is where it is mined & cleaned).

Process 5 – Ferrous chloride manufacture. The use of millscale is the best source of iron that produces the least amount of waste (all the iron is dissolved and only the oily coating remains). The size of the ion in millscale provides a greater surface area which enables the hydrochloric acid to dissolve all of the iron. There is no real safe alternative to using hydrochloric acid for this product. Any other chlorinated products used would not dissolve the iron as well, create more waste and you would not have ferrous chloride as the final product.

Process 6 – Ferric chloride manufacture. This uses the ferrous chloride manufactured in process 5, with the further addition of adding extra millscale and chlorine gas to change the product from Iron 2 to Iron 3. This is a redox reaction. Laboratory trials a number of years ago, attempted to use alternatives to chlorine, but with little or no success in producing ferric chloride.

Process 7 – Sulphuric acid evaporation. The equipment is designed to evaporate sulphuric acid, to make it a stronger product and remove any impurities. No other product can be used, as it is designed only for sulphuric acid due to the physical properties of the sulphuric acid.

Process 8 – PolyAluminium chloride manufacture. The use of aluminium hydrate powder, has long been deemed the best version of aluminium to use. Other versions such as bauxite and the use of scrap aluminium result in the production of more waste (from contaminants) and in the case of bauxite, red mud which contains high levels of heavy metals and would be an extremely hazardous waste material to dispose of. The use of any other acid apart from Hydrochloric acid, would mean that the product produced would not be PolyAluminium chloride.

Process 9 – Sodium silicate manufacture. The use of silica sand and sodium hydroxide are the necessary raw materials used to produce the grade of sodium silicate that Industrial Chemicals sells to its customers. There are other grade available that can be manufactured but require different grades of silica sand or silica stones (glass) which would then be dissolved or hydrothermally reacted to produce the different grades.

Process 10 – Sodium citrate production. Previously Industrial Chemicals would bring in already manufactured sodium citrate and just dissolve it in warm water. However due to the final destination of the product and that humans may be exposed to the product, the customer had been carrying out bacterial checks on the final product and it was deemed that just dissolving & sanitising the various vessels that were in use was not good enough. The actual exothermic reaction between sodium hydroxide and citric acid was one step more that destroyed any bacteria in the acid & the vessels. Therefore the use of the Sodium hydroxide & the Citric acid was a better method for production. Also in using these products there is no packaging that needs to be disposed of, as the raw materials are delivered in bulk tankers and then transferred to bulk storage tanks. Therefore reducing the volume of waste produced.

Process 11 – Aluminium sulphate manufacture. As with process 8, this is a very basic exothermic reaction. The use of any other type of aluminium would create more waste, but also increase the production time of the process and it would also then require the use of extra energy to create the heat to get the reaction started, unlike using Aluminium hydrate powder (which has a far greater surface area). Also if the Sulphuric acid were to be exchanged for another acid, it would not be Aluminium sulphate produced, but also if other chemicals that had a volume of sulphate in them, it would not be guaranteed that the final product would be Aluminium sulphate and more waste would also be produced.

Multi Product Protocol – in using the multi-product protocol, the sources of the raw materials would both be investigated to ensure that the least amount of waste was produced, the minimal amount of energy would be required to manufacture the product and the production time would be realistic. All of this is covered in various procedures within the Industrial Chemicals Management Systems for new product development & process design.

Appendix C3 6e – Waste Avoidance

All of the processes that are being applied for within this permit variation application all produce a volume of waste. The volumes of waste that are proposed to be created as a result of the manufacturing processes have been taken as a guide from existing manufacturing permitted facilities already operated by Industrial Chemicals Ltd.

Process 5 - Ferrous chloride & Process 6 - Ferric chloride. The volumes of waste that are proposed to be generated from these processes are a total for both processes. The reasoning behind this calculation, is that the existing facility at Runcorn has the waste for both the Ferrous chloride process removed in the same skips (they have the same waste code) as the ferrous chloride. In 2017, the Runcorn facility disposed of 166.23 tonnes of sludge from the dissolving vessels and for every tonne of ferrous/ferric chloride produced 4kg of waste is produced. This waste is made up of the oil coating that covers the raw material as a method of reducing oxidisation of the iron. This sludge has no iron content and as such cannot be either used in another process and the only alternative is to dispose of as a waste. There is no liquid waste from this process.

Process 7 - Sulphuric acid evaporator. There is no solid waste produced by this process. However there is condensate and this will be fed into the dilution process of either weaker strength acid to supply to customers or dilution water for the Ferric sulphate process. There is also a sludge of impurities that will also be produced, which is currently planned to be returned as a product to the supplier for re-use within their process. The volumes that will be created are not yet known, as the plant is not operational and has not been operational for Industrial Chemicals Ltd.

Process 8 – PolyAluminium chloride. The manufacturing process for this product has been refined during the time it has been manufactured under permit DP3637SG. One of the raw materials Aluminium hydrate, has to be added in excess, to enable all of the Hydrochloric acid to be used up (termed as no free acid). Over the years this excess has been trimmed and is currently at the point by the end of 2017, that for every tonne of product produced 13kg of solid waste was produced. A new filtration system has been installed and operational for the past 6 months and a further unit is also to be installed, thus negating the requirement for the use of press filters. This new filtration system (using a stockdale filtration system), enables the unspent aluminium hydrate to be cleaned and then put back into the reactor to start the next batch. Eventually after 50 batches, all that remains of the spent hydrate is the trace metals that cannot be dissolved by the Hydrochloric acid. This spent hydrate (as it is known) is then disposed of to landfill. It is not a hazardous waste. The wash water used by the stockdale filtration system is significantly less than of the filterpress system and due to the lower volume, it can all be used in the dilution side of the manufacturing process, unlike the filterpress washings (too much produced during this washing with the excess washing being sent to the on-site effluent treatment plant).

Process 9 – Sodium silicate. The manufacturing process for this product means that the silica sand is added in excess to the sodium hydroxide. As with process 8, the undissolved sand is filtered out and returned to the reactor for the next batch. There is as with Process 8, a point where the sand cannot be dissolved any further and at this point is washed and sent off site for disposal. For every tonne of product manufactured 0.00007te of waste is produced. As a manufacturing process, this is very minimal waste produced. The wash water is used as dilution water (to ensure the required ratio/strength of product). Overall this is a minimal waste producer. The undissolved sand is sent off-site for disposal to landfill. It is not a hazardous waste.

Process 10 – Sodium citrate. This manufacturing process produces no solid waste. The only waste that is produced from this process is the hot water used to sanitize the reactor, the storage vessel & the tanker that delivers it. This sanitization is a requirement by the customer as the product is classified as 'food grade' and has the potential to enter the human body. For almost every tonne of product produced, 1 tonne of waste water is produced. It has not yet been possible to re-use the sanitised water, as both Processes 8 & 9 re-use all the washings that they produce. However, it is assumed that there may be the potential at the permitted site BJ7298IF for the re-use of this water as dilution water. However, until the plant is constructed the distribution of the sanitising water is not known. In the worst case scenario, this water would be cooled to enable discharge to the River Thames (under the existing consent).

Process 11 – Aluminium sulphate. This process as like process 8, adds Aluminium hydrate in excess, with the excess then being rinsed back into the reactor to act as a starting agent for the next batch (start the reaction off with the sulphuric – preventing complete thermal shock to the reactor – adding dry aluminium hydrate would start an uncontrollable violent reaction, whereas using wet aluminium hydrate, will start the reaction, but it is less violent & not quite so hot. There is no waste water from this process, but over the course of a year 30 tonnes of unusable aluminium hydrate is sent for disposal, which for every tonne of product produced 3 kg of waste is produced. Due to the stones, etc. that are undissolved, the waste goes to landfill as non-hazardous.

Multi Product Protocol – for every new product introduced under the umbrella of the multi product protocol, a new trial/product proposal is put together and as part of this exercise waste has to be accounted for both from a theoretical volume and an actual volume so as the determine how much is produced, can it be reduced, can it be used elsewhere either on site or within the company or is off-site disposal the only option and then a guide for the cost is taken into account.