

WASTE ACID RECOVERY AND RE-CONCENTRATION WITH ENVIRONMENTAL PROTECTION

The Chemical industry produces thousands of tonnes of waste sulphuric acid contaminated with other mineral acids and usually an organic component. For example the production of Di- Nitro Toluene results in a waste acid of sulphuric acid contaminated with Nitric acid and partially nitrated Toluene. The recovery of these contaminated acids is usually by the traditional route of evaporation at high temperature and atmospheric pressure. DeDietrich Process Systems (DDPS) has the expertise and experience to process this acid and others like it in a clean modern plant to produce acid for re-use without contaminating the environment.

The traditional route for re-concentrating sulphuric acid is the so called pot or drum concentrator where the acid is either boiled at high temperature in a silicon iron pot or combustion gases from burning gas or oil are passed directly through the acid in ceramic brick lined drums. The consequence of this high temperature operation is the evolution of exhaust fume consisting of combustion products of the organic contaminant and often significant amounts sulphuric acid mist. The equipment is prone to corrosion if the product acid temperature drops below 98% and results in high maintenance costs but more importantly results in loss of operating hours every year.

Through the DDPS company, QVF, a reliable and environmentally friendly design of recovery system has been developed to handle a wide range of waste acid streams from the Chemical Industry. The designs of plant are tailored to the type of waste acid based on experience gained over the past 40 years of working in the Chemical Industry. The initial plants were supplied to factories involved with the production of explosives, because of course, traditional explosives are nitrated organic materials. The waste acid from the production of NitroGlycerine is approximately 70%w/w Sulphuric acid, 12%w/w Nitric acid, 2% nitroglycerine in solution and the balance water. Clearly the acids must be separated and if possible concentrated for recycle. The DDPS solution involves a stripping column which firstly decomposes the Nitroglycerine and then recovers 98.5% Nitric acid as a top product from the so called Denitration column. The residual 70% sulphuric acid from the base of the column passes to a vacuum concentration system to recover 96% sulphuric acid.

The waste acids being produced in the commercial factories are some what similar to the example above and DDPS have drawn on this experience to tackle the wide variety of problems encountered in China's expanding Chemical Industry. An example is the treatment of waste acid arising from the manufacture of Nitro Chloro Benzene.



The plant in the diagram is based on the QVF horizontal concentrator which is specifically designed for sulphuric acid concentration. For concentration up to 88% w/w the concentrator operates at an absolute pressure of approximately 80 mbar which limits the boiling point of the 88% acid to 169°C. This allows the use of steam at 16 barg to be used for heating using a tantalum bayonet heater in a glass lined steel shell. The flow pattern within the concentrator is almost entirely plug flow because

of specially designed internals and thus the boiling point rises steadily along the concentrator as the acid is concentrated. This allows a true Logarithmic mean temperature difference (LMTD) to be used in calculating the heat transfer area. This is in contrast to the circulatory type concentrators where all the acid is at the outlet temperature and concentration. The result is that the horizontal unit minimises the amount of costly tantalum used in the plant.

The vapours evaporated from the NCB waste acid contain water, NCB and NOx from decomposition of the small amount of nitric acid in the feed together with the sulphuric acid vapour which corresponds to the partial pressure of H₂SO₄ above the boiling acid. The water and NCB are condensed under vacuum at approximately 45 C. The water is discharged to waste with a very low sulphuric acid content. The added complication, which occurs with many organic contaminants, is the crystallisation of NCB in the condenser. The DDPS design is flexible enough to allow the vacuum and the condensing temperature to be controlled such that the NCB remains liquid and can be recovered from the waste water discharge. The vapours to the condenser can contain significant amounts of sulphuric acid, more particularly at lower pressures such as 13 mbar when concentrating to 96%w/w. However at any vacuum level it is practical to install a scrubbing column, before condensation to minimise the loss of sulphuric acid to the environment. The exhaust from the vacuum pump can contain Nitrous fumes (NOx) and to avoid discharge of this fume to atmosphere they are re-absorbed to recover nitric acid. The exhaust from the nitric acid absorber may also be fitted with a NOx destruct unit to protect the atmosphere.

DDPS expertise has been applied to several waste acid recovery plants within China with the clear advantage of being able to obtain clean concentrated sulphuric acid, minimum losses of sulphuric acid, nitric acid and Organic product. In addition because this is done at low temperature and pressure there is a maximum protection to the environment.

REFERENCE SAC PLANTS IN CHINA

ACID TYPE	CAPACITY kg/h	FEED%	PROD%
NCB	8400	72%	88%
DNT	3000	70%	96%
NB	8100	69%	88%
NCB	3630	72%	90%
NCWA	2100	65%	96%
confidential	10800	65%	83%
confidential	3000	65%	94%
confidential	1050	65%	96%

