Tialoc Chemical Resistant Piping Systems
Background on tialoc:

The tialoc Group was founded in 2000 in Germany and 2001 in Singapore, with the focus on supplying high quality engineered environmental solutions, at competitive prices, for the European, Chinese and SE Asian markets.

Very quickly, tialoc grew to be a multi-million dollar company, with presence in five continents, employing over 450 staff in four divisions. tialoc is now recognized as being a specialist in process engineering, design and EPC “lump-sum turn-key” supply of waste gas and water treatment systems, as well as having premium quality, in-house composite fabrication capabilities.

Originally tialoc specialized in the chemical and semiconductor industries, but now also has a strong presence in the automotive, industrial, oil & gas, pharmaceutical, petrochemical, and mineral processing sectors.

Manufacturing at tialoc:

Our manufacturing division – tialoc Composite – has its major locations in China, Malaysia and Germany as well as smaller production facilities in Vietnam and Thailand.

The Composite division specializes in the materials selection, engineering, design and manufacture of world class fabricated plastic, FRP and dual-laminate products, most commonly pipes, tanks and reaction vessels at elevated temperature and pressures.

All our products are manufactured to strict international engineering codes, with 25 year design life, so you can be assured of the quality and have confidence in the long-term performance of the products. In recent times we have earned the enviable reputation as being the premier supplier of chemical resistant piping systems in hazardous applications in Asia.
Introduction to our piping systems:

Tialoc design and fabricate specialty chemical resistant pipes for a wide range of applications, including acids, alkali’s, organics and gases, often at elevated temperatures and pressures. Where there is a difficult chemical piping application, tialoc will provide the solution.

Tialoc has personnel with over 30 years of experience in manufacturing chemical resistant pipes, predominately in plastic, FRP and dual-laminate fabricated spooling. tialoc pipes are fabricated on a rotating mandrel under controlled factory conditions, so you can be assured of consistent quality, regardless of length of pipe, or size of project.

Our pipes can be manufactured with an extensive range of products and design features, such as multiple choices of plastic in-liner, FRP outer layer, surface protection, pipe diameter and length, branching, end connections and all international standards accommodated.

Features include:
- 3D designed piping system
- Pre-formed bends
- Fixed or loose flanges, or “quick-lock” end fittings
- Expansion/reduction pieces
- T or Y piece branch spooling
- Antistatic & fire retardent
- In-house factory tested
- Preassembled modular systems
Features in Detail:

- In-house selection of materials, piping design calculations and a full suite of drafting capabilities including 3D and isometric drawings.

- Pipes designed to international standards such as AD-Merblatt N1, DIN EN 13121-4, DIBt40-B1/B2, BS4994.

- Design temperatures up to 160 degrees and 16 bar pressure.

- Options to be fabricated from pure plastic, pure FRP or dual-laminate (plastic lined FRP).

- Antistatic, wear resistant and fire retardant additives available.

- Materials of construction from premium suppliers such as Roechling, Symalit, Agru, Ashland, DSM and Saint Gobain.

- Wide selection of plastic in liners, such as PE, PVC, PP, PVDF, ECTFE, PFA, FEP or pure FRP.

- Current fabrication capabilities to produce pipes up to 12m long, and 6.5m diameter. Larger pieces can be fabricated upon request.

- Complete, modular construction of piping systems.

- On site installation and project management capabilities in many regions globally.
Materials:

The products manufactured at tialoc, make use of only the highest standard materials, typically European imported goods to ensure the consistency of quality required.

Our raw plastic material is typically sourced from either Agru, Roechling or Symalit, while the resins are either purchased from Ashland, DSM or Swancor, and the glass fibre from Saint Gobain, CPIC, Taishan or equivalent.

Tialoc soley uses epoxyvinylester resins to meet the chemical and structural requirements at elevated temperatures and pressures. The following resins are used for the various applications:

<table>
<thead>
<tr>
<th>Brand</th>
<th>Std</th>
<th>HT</th>
<th>FR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derakane</td>
<td>411</td>
<td>470</td>
<td>510</td>
</tr>
<tr>
<td>Atiac</td>
<td>430</td>
<td>590</td>
<td>N/A</td>
</tr>
<tr>
<td>Swancor</td>
<td>901</td>
<td>907</td>
<td>905</td>
</tr>
</tbody>
</table>

Std = standard; HT = high temperature; FR = fire retardent

Commercial grade E and C glasses are used within the FRP structure.

<table>
<thead>
<tr>
<th>Material</th>
<th>Chemical Resistance</th>
<th>Temperature (°C)</th>
<th>Availability</th>
<th>Weldability</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Sheet</td>
<td>Pipe</td>
</tr>
<tr>
<td>PE</td>
<td>+</td>
<td>-10</td>
<td>60</td>
<td>++++</td>
<td>++++</td>
</tr>
<tr>
<td>UPVC</td>
<td>+</td>
<td>-10</td>
<td>60</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>PP</td>
<td>++</td>
<td>-15</td>
<td>95</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>CPVC</td>
<td>++</td>
<td>-10</td>
<td>90</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>PVDF</td>
<td>+++</td>
<td>-40</td>
<td>150</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>ECTFE</td>
<td>+++</td>
<td>-76</td>
<td>160</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>PTFE</td>
<td>+++</td>
<td>-200</td>
<td>260</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>FEP</td>
<td>+++</td>
<td>-190</td>
<td>205</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>PFA</td>
<td>+++</td>
<td>-190</td>
<td>260</td>
<td>O</td>
<td>+</td>
</tr>
<tr>
<td>MFA</td>
<td>+++</td>
<td>-190</td>
<td>250</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Thermoplastic comparison table:
What is Composite / Dual-laminate?:

The vast majority of our successes have been in the supply of composite, or more accurately, dual-laminate products.

Dual laminates consist of a thermoplastic in-liner (e.g. PE, PP, PVC, PVDF, ECTFE, FEP, PFA) bonded to an outer FRP layer.

Dual laminates combine the outstanding mechanical strength of FRP with the high chemical resistance of plastics.

Tialoc’s dual laminate process piping system has several advantages when compared to other materials (e.g. Stainless Steels, PTFE/Steel and Glass Lined Steel) commonly used as piping in corrosive environments.

Advantages of Dual Laminates:

- Excellent chemical resistance
- High vacuum stability
- High design flexibility
- Ease of modification and repair after construction
- Reduced maintenance costs as:
  - FRP is corrosion resistant
  - Easy to clean and maintain
  - Dual Laminate material requires minimal external protection
- Reduction of flanged connections (as parts are connected through joint lamination), which results in:
  - Reduced leakage
  - A lightweight construction
- UV protection, fire retardant additives available and almost any colour scheme possible
- Excellent shock resistance and flexural strength properties
- Superior thermal insulation properties avoiding the requirement for pipe cladding
- Significantly lower cost when compared with exotic steels
Production Facilities:

Tialoc maintains workshops in three important locations globally.

Germany (first two photo’s right):

Tialoc has German production facilities located at Ransbach-Baumbach, ~1 hour from Frankfurt. The facilities consist of the following:
- 1,100m² - Workshop 1 (Plastics)
- 500m² - Workshop 2 (FRP)
- 100m² - Office Area
- Around 10 personnel

China (third photo right):

Tialoc has its China workshop production facilities located at Shanghai ~1 hour from the international seaport. The facilities consist of the following:
- 2,000m² - Workshop 1 (Plastics)
- 6,000m² - Workshop 2 & 3 (FRP)
- 600m² - Office Area
- 900m² - Workshop 4 (Sino-Fab) teflon coated steel ductwork
- Around 80 personnel

Malaysia (photo bottom right):

Tialoc has its SE Asia workshop located at Kulim, Malaysia ~1 hour from the international seaport of Penang. The facilities consist of the following:
- 3,500m² - Workshop (Total)
- 200m² - Office Area
- Around 40 personnel
Machinery and Tools:

Winding machines – over 20 pcs:

Tialoc composite has an extensive range of tools to fabricate almost any product from thermoplastic and/or FRP material. Our team in all locations have DVS (German) certified craftsmen, so the quality can be assured.

CNC sheet welding machine – 3 pcs:

Welding guns – over 50 pcs:

Lathe – 6 pcs:

Hot plate pipe welder – over 20 pcs:

At full capacity, with current resources, we are able to produce up to 4-5km of pipe, 8-10 tanks, or a combination of both, every month. We can also ramp-up to greater capacity if required. Our largest projects to date are 30km of pipe for Bayer & over 50 FRP tanks for Lynas.
Manufacturing & Installation Process:

The process of manufacturing and installing dual-laminate pipe is divided into six broad steps, which are illustrated in the following images.

- **1st Step** – Intermediate fabric
- **2nd Step** – Lamination
- **3rd Step** – pre-spooling
- **4th Step** – Welding on site
- **5th Step** – FRP wrapping on site
- **6th Step** – Installed pipe testing

The pre-spooling step allows pieces to be joined and tested at our facilities under controlled factory conditions, greatly reducing the site installation time, therefore reducing project schedule and ultimately cost.
Connections:

Tialoc supplies the full range of fittings in accordance with DIN Standard. All international standards are catered for, and tailor made (non-standard) fittings can be manufactured on request. Standard joining methods of pipes and pipe components are either flange connection or Butt-joints.

Butt Joints:

This technique is applicable for all pipe-classes. It reduces the number of flanges, therefore decreasing the risk of leakage. Butt-Joints for lined FRP pipes require two steps – welding of the plastic in-liner, then lamination of the FRP outer layer. Welding is either by heating element method or by hand-held hot-gas filler-rod. These techniques need to be executed with special tools and in accordance with DVS guidelines.

The Joint lamination is by hand lay-up method and in accordance with DIN 16966-8. Before lamination, the weld seams will be backed with an electro conductive carbon veil to detect possible pin-holes by spark testing. The image below is of a typical plastic lined FRP butt joint profile.

Flange Connections:

Flange connections are designed according to DIN 16966-8 with standard flange patterns to DIN EN 1092-1 (PN10) or ANSI 16.5B (150#). Alternative flange standards can be supplied upon request. Tialoc supplies two basic flange connections – fixed or loose. The two images below are our fixed flange type.

Below is a design of our loose flange.
In-house Quality Testing:

Tialoc maintains strict quality control throughout the manufacturing process.

Each weld is tested and issued with an individual seam certificate, which is subject to normal welding protocol, i.e. spark test, type of weld, material, name of worker, date, temperature, humidity, etc. providing traceability and peace of mind to the client.

Welders at tialoc are trained and certified to German DVS standards.

We have our own testing laboratories (photo above) at all three manufacturing locations, to perform various strength tests. Pressure test in photo below.

We are able to perform pressure and burst tests in-house to international standards (burst test in photo above).
Standards:

All products fabricated by tialoc follow strict international standards. Our pipe’s are manufactured according to the following standards:

- DIN 16965-2/4/5 – Pipes from glass fibre reinforced polyester resins
- DIN 16966-2/4/5/6/8 – Fittings from glass fibre reinforced polyester resins
- DVS 2202-1 – Imperfections in thermoplastic welding joints
- DVS 2203-1/2/5 – Testing of welded joints of thermoplastic sheets and pipes
- DVS 2212-1 – Examination of plastic welders – hot gas & butt welding
- DIN 527-4 – Determination of tensile properties
- DIN EN 1172 – Determination of textile glass content
- DIN EN 14125 – Determination of flexural properties
- DIN 53769-1 – Determination of longitudinal shear strength of lined FRP piping systems
- DIN 53758 – Short term pressure test – Determination of burst pressure strength
- DIN EN 59 – Determination of barcol hardness
- VDE303 – Determination of electric conductive properties of plastic materials

Fabrication of our piping to other standards is available upon request, for example ASME, GB and BS are very often employed.

Our fabricators are DVS certified by Tuv&Tuv on all tialoc sites.

All three major tialoc manufacturing locations are ISO 9001 certified.
Tialoc engineers have developed their own in-house standard PN10 pipe class system as per table below.

<table>
<thead>
<tr>
<th>Class</th>
<th>In-liner material</th>
<th>Pressure (bar)</th>
<th>Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A10</td>
<td>PVC</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>B10</td>
<td>PPH</td>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>C10</td>
<td>PVDF</td>
<td>10</td>
<td>110</td>
</tr>
<tr>
<td>C10-el</td>
<td>PVDF-el</td>
<td>10</td>
<td>110</td>
</tr>
<tr>
<td>D10</td>
<td>FRP</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>D10-el</td>
<td>FRP-el</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>E10</td>
<td>FRP</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>E10-el</td>
<td>FRP-el</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>F10</td>
<td>ECTFE</td>
<td>10</td>
<td>120</td>
</tr>
</tbody>
</table>

Class A10:
Pipes and pipe components of tialoc pipe class A10 are designed with a PVC in-liner. PVC has excellent resistance to a wide range of strong acids and alkalis. PVC is also resistant to most oxidizing agents such as Ozone (O₃), Chlorine (Cl₂) or Hydrogen Peroxide (H₂O₂) which gives it an advantage over PP or PE. PVC is generally unsuitable for use with chlorinated Hydrocarbons, ketones and nitro components which causes swelling and softening.

Class B10:
Pipes of pipe class B10 are designed with a Polypropylene (PP) in-liner. PP is resistant against diluted solutions of salts, acids and alkalis, but shows destruction by stress cracking if these solutions are strong oxidizing agents such as Ozone (O₃), Chlorine (Cl₂) or Hydrogen Peroxide (H₂O₂).

Class C10:
C10 class pipes are designed with a PVDF (Polyvinylidene-Fluoride) in-liner. PVDF has an outstanding resistance to most in-organic and organic acids but is unsuitable in an alkaline environment with a pH-Value ≥12.

Class D10:
D10 Class pipes have a high quality FRP in-liner as the corrosion barrier, which is a chemical resistant resin rich layer of min. 2.5mm thickness with a max. glass content of 30±5%. Epoxy vinyl ester resins offer excellent resistance to most acids, alkalis, bleaches and solvents.

Class E10:
Pipe Class E10 is a pure FRP pipe class with low glass content and increased wall thickness. It has excellent chemical resistance with increased emergency capacity at an elevated temperature.

Class F10:
Pipe Class F10 uses an ECTFE in-liner. ECTFE has outstanding chemical and thermal resistance to most chemicals including oxidized acids and organic solvents.

All pipes make use of an external reinforcement laminate (FRP) layer, which is a composition of Woven glass fabrics and Polyester Resin to absorb forces in axial and circumferential direction. Standard pressure rating is PN10 with a safety factor 6 (burst pressure: 60bar). Upon request, tialoc can design higher spec pipes.
**FRP Pipe Characteristics:**

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Unit</th>
<th>Pipe Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A10</td>
</tr>
<tr>
<td><strong>General Properties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inliner Material</td>
<td>-</td>
<td>PVC</td>
<td>60</td>
</tr>
<tr>
<td>Specific Density inliner</td>
<td>DIN ISO 1183</td>
<td>g/cm³</td>
<td>1.45</td>
</tr>
<tr>
<td>Specific Density reinforcement</td>
<td>DIN ISO 1183</td>
<td>g/cm³</td>
<td>1.9</td>
</tr>
<tr>
<td>Glass content</td>
<td>DIN EN ISO 1172</td>
<td>%</td>
<td>60±5</td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>-</td>
<td>bar</td>
<td>10</td>
</tr>
<tr>
<td><strong>Mechanical Properties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burst pressure</td>
<td>DIN 53758</td>
<td>bar</td>
<td>60</td>
</tr>
<tr>
<td>Tensile Strength (circum.)</td>
<td>DIN 53758</td>
<td>N/mm²</td>
<td>360</td>
</tr>
<tr>
<td>Tensile Strength (axial)</td>
<td>DIN EN ISO 527-4</td>
<td>N/mm²</td>
<td>180</td>
</tr>
<tr>
<td>Flexural Strength (circum.)</td>
<td>DIN EN ISO 14125</td>
<td>N/mm²</td>
<td>360</td>
</tr>
<tr>
<td>Flexural Strength (axial)</td>
<td>DIN EN ISO 14125</td>
<td>N/mm²</td>
<td>180</td>
</tr>
<tr>
<td>Tensile Modulus of Elasticity (circum.)</td>
<td>DIN 53758</td>
<td>N/mm²</td>
<td>17000</td>
</tr>
<tr>
<td>Tensile Modulus of Elasticity (axial)</td>
<td>DIN EN ISO 527-4</td>
<td>N/mm²</td>
<td>10000</td>
</tr>
<tr>
<td>Flexural Modulus of Elasticity (circum.)</td>
<td>DIN EN ISO 14125</td>
<td>N/mm²</td>
<td>16000</td>
</tr>
<tr>
<td>Flexural Modulus of Elasticity (axial)</td>
<td>DIN EN ISO 14125</td>
<td>N/mm²</td>
<td>8000</td>
</tr>
<tr>
<td>Shear strength (Liner-FRP)</td>
<td>DIN 53769-1</td>
<td>N/mm²</td>
<td>7</td>
</tr>
<tr>
<td>Interlaminar Shear strength</td>
<td>DIN 65148</td>
<td>N/mm²</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Thermal Properties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal expansion coefficient (circum.)</td>
<td>DIN 53752</td>
<td>1/C°</td>
<td>15*10⁶</td>
</tr>
<tr>
<td>Thermal expansion coefficient (axial)</td>
<td>DIN 53752</td>
<td>1/C°</td>
<td>25*10⁶</td>
</tr>
<tr>
<td><strong>Electrical Properties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific volume resistance</td>
<td>VDE 0303</td>
<td>Ωm</td>
<td>n/a</td>
</tr>
<tr>
<td>Specific Surface resistance</td>
<td>VDE 0303</td>
<td>Ω</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Conductive FRP:

Many applications demand the superior chemical resistance of plastics or FRP over steels, however in the presence of organics, the risk of static build-up and ultimately explosion is ever present.

To combat this, tialoc has developed its own “conductive” FRP, which has unique anti-static properties and is able to dissipate and earth any potential electrical charge.

The material employs the addition of carbon graphite powder with the resin to conduct the charge.

The exact amount is crucial. If not enough is added, the risk of static build-up is still present. If too much is added, the FRP becomes hard and brittle.

All tialoc conductive FRP pieces are tested for conductivity and strength before dispatched. If any fault is discovered, it is scrapped and remade.

We have supplied our conductive FRP to several projects recently, references below:

<table>
<thead>
<tr>
<th>Customer</th>
<th>Project</th>
<th>Length (m)</th>
<th>Size (NB)</th>
<th>Year</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayer</td>
<td>HDI4</td>
<td>600</td>
<td>25-200</td>
<td>2009</td>
<td>Shanghai, China</td>
</tr>
<tr>
<td>LDK</td>
<td>Polysilicone</td>
<td>200</td>
<td>50-200</td>
<td>2009</td>
<td>Xinyu, China</td>
</tr>
<tr>
<td>Bayer</td>
<td>TDI Core</td>
<td>400</td>
<td>25-200</td>
<td>2010</td>
<td>Shanghai, China</td>
</tr>
<tr>
<td>Akzo Nobel</td>
<td>DCP</td>
<td>7 / scrubber</td>
<td>2200</td>
<td>2010</td>
<td>Ningbo, China</td>
</tr>
<tr>
<td>Bayer</td>
<td>MDI</td>
<td>500</td>
<td>25-200</td>
<td>2011</td>
<td>Shanghai, China</td>
</tr>
<tr>
<td>Lynas</td>
<td>LAMP</td>
<td>500</td>
<td>80-500</td>
<td>2012</td>
<td>Gebeng, Malaysia</td>
</tr>
<tr>
<td>BASF</td>
<td>MDI</td>
<td>12 / scrubber</td>
<td>600/1500</td>
<td>2013</td>
<td>Chongqing, China</td>
</tr>
</tbody>
</table>
Case Study – Large Piping Project:

In 2007, Bayer, one of the world’s leading producers of polymers and high performance plastics built a new manufacturing plant for Methylene Diphenyl Di-isocyanate (MDI) in Shanghai, China. The photo’s above and below are of the finished plant.

Tialoc designed, fabricated and installed the dual-laminate piping system.

The manufacturing of pipe and fittings took place in China, Malaysia, Germany and Poland. Over 250 tons of material was transported to site, consisting of around 20km of piping and more than 15,000 fittings, from 25–1600NB up to 17 metre long pieces. Over 20,000 plastic welding seams were performed on site. At peak level, tialoc managed around 200 personnel on the project.

Tialoc provided the complete dual-laminate piping system as a turn-key project including the following:

- PP2222/FRP liner pipes and fittings
- PVC-U/FRP liner pipes and fittings
- PVDF/FRP liner pipes and fittings
- Type E pipes and fittings
- Secondary support (pipe clamps with inlay)
- Project management
- Logistics & jobsite management
- Safety & QAQC management
- Installation and commissioning
- Testing, reporting & documentation
- Supply and installation of gaskets, nuts and bolts
- Communication between Bayer and local authorities
- Continual monitoring and supply of additional 10km of piping
Modular Systems – Solvay Thailand:

Solvay, which originated in Belgium in 1863, is now one of the world’s largest multinational chemical companies. In 2011, it contracted tialoc to supply and install a complex piping system to handle brine solutions in the filter section of the Vinythai chlor-alkali plant in Thailand.

Within five months from ordering, tialoc was required to engineer, design, construct, assemble, factory-test, disassemble & pack, deliver, reassemble, re-test and commission the complex piping system including the steel structure, platform and stairs.

The manufacturing of pipe and fittings took place wholly in our factory in China. In total, tialoc provided the client with around 250m of piping and approximately 600 fittings. Around 15 plastic welding seams were also performed on site. At peak level, 8 tialoc staff members were involved in the project.

Approximately 45 tons of material in 650 individual pieces were transported via sea freight to the project site in Thailand within three 40ft, and one 20ft shipping containers. In early 2012 the unit was successfully installed and commissioned.

The recent trend globally has been to supply increasingly “modularised” units. Solvay is no different, and they contracted us to supply the filter piping system on this basis. The advantages are better quality control, faster, cheaper and safer production, and most importantly – fewer sites welds. In this instance, the site requirement for plastic/FRP welding was reduced from over two hundred to less than twenty.
Modular Systems – SAP, Saudi:

In 2011, Fluor contracted tialoc to supply an extensive range of equipment to Evonik’s Super Absorbent Polymer (SAP) project in Al-Jubail, Saudi Arabia. This was on an EPC fixed-price lump-sum basis with a preference for modularisation to minimise site installation time.

Photo below of the pre-assembled pump and heat exchange skids in our Malaysian workshop ready for dispatch.

Our equipment was employed to treat emitted VOC’s. The gas was first cooled in the quench scrubbers then the packed bed scrubbers neutralized the organic acids. The “clean” gas was vented to atmosphere via our fans and stacks. The waste solution was sent to a treatment system using our pumps.

All the equipment for this project was assembled in our Malaysian workshop and in 2013, the units were successfully installed and commissioned.

Photo’s top and below of the modular units installed on site in Saudi Arabia

The products we supplied were as follows:

- 4 x FRP Packed bed scrubbers, up to 3.6m Diameter x 14m High
- 4 x Duplex SS Quench scrubbers, up to 1.8m Diameter x 7m High
- 4 x FRP stacks
- 8 x Centrifugal pumps on skids
- 4 x Extraction Fans
- 4 x Heat Exchangers on skids
- 4 x static mixers
- Instrumentation, Valves, VSD’s and extensive piping system
3D Computer Modelling Capabilities:

Processing plants have become increasingly complex in recent years. 3D modeling is now commonly employed to better understand the proposed layout, and identify where potential conflicts may exist.

Tialoc engineers are experienced and highly competent with 3D modelling, and now employ this in all our major projects.

The image above is of our kiln off-gas treatment system for Lynas in Gebeng, East Malaysia. We installed and early 2013 commissioned phase 1 (shown).

The image to the left is the off-gas treatment system at Corning’s glass factory in Taichung, Taiwan.

The image below of the complete piping system we supplied to Solvay’s chlor-alkali plant in Thailand in 2012.
Other References

Tialoc's dual laminate piping systems have been supplied to numerous corrosive industrial environments such as chemical, pharmaceutical, oil & gas, and mineral processing plants.

Tialoc manufactured and installed pump, in-line filter & pipe system for Lynas in Malaysia.

Tialoc manufactured piping system for Westlake’s chlor-alkali plant in Louisiana USA.

Tialoc’s dual laminate pipes are:
- Typically 25-1200mm, larger possible.
- Temperatures up to 160°C.
- Design pressures up to 16bar.

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