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Abstract title: Hazardous Decommissioning: Planning for success

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ABSTRACT

Following the sale and subsequent shutdown of Qenos, a number of remaining process safety hazards required resolution to make the site safe. The most significant involved management and neutralisation of ~15 tonnes of titanium tetrachloride (TiCl_4). Identifying and executing a safe method to remove and treat this material was the early critical-path activity for the shutdown.

TiCl_4 reacts violently with atmospheric moisture to form hydrochloric acid vapour presenting acute risks to personnel and the environment. The limited publicly available technical guidance for large-scale disposal suggested hydrolysis in excess water with caustic addition, with the reaction producing titanium dioxide, sodium chloride and water. As the hydrolysis reaction is rapid and highly exothermic, therefore understanding reaction kinetics, heat generation and mass transfer limitations were essential to designing and implementing a safe process.

Alternative offsite disposal options were explored, however the requirement to exclude oxygen during transfer and processing proved impractical. On-site treatment was therefore pursued, requiring temporary approval from the environmental regulator. Completing the bulk of the neutralisation process prior to plant shutdown reduced the inherent risk on site during equipment and piping preparation and had the additional benefit of saving two Olympic-sized swimming pools of water.

Multiple options were screened, resulting in two viable approaches: repurposing existing process reactors, or controlled hydrolysis in the open-air effluent system and utilising existing caustic facilities. While initial intuition favoured reactor-based processing, systematic hazard review identified multiple challenges including potential line blockages, low pH excursions, air ingress and cross contamination.

The effluent system provided a safer and more inherently robust solution. The final design incorporated multiple independent layers of protection including submerged discharge two metres below the liquid surface, a distributor plate to manage bubble size and reaction rate, corrosion-resistant materials in low pH zones, limiting maximum flow, leak testing and

calibrated gas detection.

Selecting an approach that deliberately introduced $TiCl_4$ to water, contrary to established operating practices, generated understandable concern among operating and maintenance teams. Significant effort was invested in communication and training, supported by extended on-site engineering presence during commissioning and operation to provide assurance to the workforce.

More than 1,000 engineering hours were invested over several months to design, review, approve and execute the solution. This case study highlights the value of rigorous options analysis, inherent safety thinking and ensuring the workforce understood how risks were managed through the application of process safety principles by a skilled multi-disciplinary team.

KEY WORDS

Decommissioning, Process Safety, Waste Management, Site makesafe, Shutdown, Hazardous Chemical handling

BIOGRAPHY

Kathryn McDonald is an experienced professional in industrial operations and risk management with a background in major hazard facilities. Her experience includes process safety, operations excellence and continuous improvement and the practical management of hazardous materials across the lifecycle of industrial facilities, including shutdown and decommissioning activities. Kathryn has a strong interest in governance, risk oversight, and the application of emerging and existing technologies to improve operational decision-making.

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