



CEFIC Responsible Care Awards 2009 – Pentagon entry form

Summary of Pentagon's Waste Minimisation Project

Pentagon, in common with many chemicals manufacturers, consumes significant quantities of energy and raw materials, and generates significant volumes of hazardous waste. These are major costs to the business and the aim of the project was to make drastic reductions in these costs by reducing, recycling and re-using this waste. As well as reducing costs, there would be a significant reduction in environmental impact.

Waste Minimisation Teams were set up to identify new ways to reduce solvent usage, increase product yields, and improve energy efficiency. This entailed a solvent usage and waste analysis, yield improvement opportunity analysis, and energy mapping analysis.

The analyses highlighted the largest generators of hazardous waste and options for reductions in solvent usage, significant yield improvement opportunities for two key revenue streams, major sources of wasted energy and energy efficiency improvement opportunities.

The Teams developed these opportunities into specific improvement projects. These were low cost, projects promising massive savings in solvent costs, reduced hazardous waste, reduced raw material costs, and reduced energy costs.

The overall Waste Minimisation Plan targeted savings of **£1009K for the year**. The main elements were:

- Solvent savings of £450K through in-plant recovery and recycle of toluene, and recycle of SBP3, acetone and isopropanol.
- Raw material savings of £108K through elimination of variation and yield improvement on a key product.
- Energy savings of £81K through reduced consumption of gas and electricity.

The project has been a remarkable business success and has delivered **cost savings totaling £1.26m**, exceeding the target of £1.0m.

The saving in purchases of new solvents amounted to £569K (1000 tonnes). This also resulted in a reduction of 1000 tonnes of hazardous waste leaving Pentagon.

Raw material savings from yield improvements amounted to £284K. Furthermore, extra product was produced with a total sales value of £850K at a cost of:

- zero materials
- zero energy
- zero plant capacity
- zero manpower
- zero waste

Savings in gas and electricity consumption totaled £407K



These cost reductions had a major impact on business performance and have contributed to the sustainability and reputation of Pentagon.

- Customers are impressed with what we have achieved.
- Employees embrace waste minimisation and have come forward with other solvent recycle suggestions, which have been implemented and are saving money.
- Regulators acknowledge the improved efficiencies and reduced environmental impact.
- The achievements of this project helped Pentagon win the prestigious Chemical Industries ABB Manufacturing Award in 2008.
- Pentagon won the Manufacturing Institute Best SME Award in 2008
- Pentagon won the Chemicals Northwest Company of the Year Award in 2009.
- Pentagon was also highly commended for the IChemE 2008 Awards for innovation and excellence.

This project is part of Pentagon's drive for continuous improvement. The Waste Minimisation Teams define a new Plan each year. These will further improve business performance, and further improve the sustainability and reputation of the business.

These achievements have helped Pentagon win back a major product in 2009. This had been taken away by a major customer to an Indian producer in 2005.

Supporting information

- 1. Innovative approaches to increase resource and energy efficiency**
- 2. Commitment to Sustainable Development**
- 3. Leading edge approaches to excellence in Health and Safety**
- 4. Community Outreach initiatives**
- 5. Young employees and Responsible Care**
- 6. Improvement Roadmap**
- 7. More for less 2008**
- 8. Solvent recovery and recycle 2007-2008**
- 9. Energy consumption 2006 - 2008**
- 10. Borehole water usage 2003-2008**
- 11. Waste Minimisation Plan 2008 - 2009**
- 12. The Lean Approach to Manufacture at Fine Chemicals**
- 13. First aid injuries vs near miss reports 2004 – 2008**
- 14. Community Outreach initiatives**
- 15. Young employees and Responsible Care**
- 16. Pentagon launches Sustainable Development Plan**
- 17. SAP Business ByDesign**



Innovative approaches to increase resource and energy efficiency

The solvent recovery operation was established at minimal cost with the clever use of existing process equipment and control systems. The solvent recovery process was fully integrated into the existing manufacturing process and involved minimal materials movement and handling. This enabled the recovery and recycle of a total of 1000 tonnes of solvent, saving Pentagon almost £600K.

An in-depth analysis of variance was carried out on a product which is a key revenue stream. This revealed a subtle processing variable that was a key factor for yield. Because of this, yields varied from 80% to 90% with an average of 85%. The operating procedure was refined, and all the plant operators were trained and coached until a consistent high yield was established. The variation in yield was virtually eliminated and the average yield increased to 90%. The impact on output was dramatic with extra product, to the sales value of £600K, produced free of charge.

Energy mapping revealed that base load was the major consumer of gas and electricity. Much electrical equipment was under-utilised and operating inefficiently. Rationalisation of refrigeration equipment led to significant efficiency gains. Elimination of steam leaks was doubly efficient, leading to a marked reduction in gas consumption, and also enabling one boiler to be taken off standby and shut down. Total energy consumption was reduced from 53.2 to 40.5 GWhrs pa, which equates to a reduction of 2894 tonnes of carbon dioxide emissions. At the same time production output was increased from 639 to 709 tonnes, a reduction of 31.3% in specific energy usage.

Commitment to Sustainable Development

The project was carried out within the wider context of Pentagon's Sustainable Development Plan which is aligned with the Chemical Industries Association Goals and Guiding Principles for Sustainable Business Practice. These goals cover all aspects of how we do business are summarised below:

Pro-active, looking beyond legal compliance

Safety the highest priority

Productivity and resource efficiency

Innovation

Fairness

Respect for people and communities

Working environment

Openness

Leadership



Compliance

Endorsement

Headline achievements are as follows:

- **Incidents:** Strong process safety leadership and a rolling Process Safety Improvement Plan. The target is no major personal injuries or plant incidents.
- **Occupational Health & Safety:** Responsible Care achievements with >1 million hours without an LTA at Specialties, and Fine Chemicals into its fourth year without an LTA.
- **Resources:** More product for less through yield improvement and process optimisation. Dramatic waste reductions through solvent recovery, utilising existing plant at minimal cost.
- **Energy:** Over 30% reduction in specific energy consumption and over 6000 tonnes reduction in carbon dioxide emissions in 2008 compared with 2006.
- **Productivity:** Up to 65% increase in output through clever use of existing plant, improved equipment performance and elimination of variance.
- **New business:** New product introductions through Product Team innovation in partnership with Customers.
- **Working Environment:** Operate a working environment that promotes productivity ownership, employee engagement and development, so that all strive to give their best. Acknowledged Competency Management System developing our people.
- **People and communities:** Reputation and recognition through awards, conferences, publications, school visits and other community projects.
- **Supply chain:** A multi-disciplinary project team, Project Novus, working in conjunction SAP UK, has recently implemented an MRP system. Pentagon has become one of the first users within the UK of this new SAP platform called "**Business ByDesign**" which is specifically designed for our size of business. It is a web hosted integrated software package which links all the elements of the business together. This is improving our capability to give customers what they want, when they want it (on time and in full). Additionally, it is providing the Company with real time information in terms of availability and cost. This has enabled better planning and improved the efficiency of the business processes. It also aligns our business metrics with those of our customers, right down to the unit of measure.

The achievements of the Sustainable Development Plan are wide-ranging and substantial, particularly those related to Waste Minimisation.



Leading edge approaches to excellence in Health and Safety

Process Safety Leadership

Pentagon is at the forefront of process safety leadership. The CEO is a high profile member of the CIA Process Safety Leadership Group.

Pentagon, through organisational development, has a unified Process Safety Management (PSM) approach across the group. This is clearly defined, through the focused roles of process safety champions at each site supported by the group compliance and audit functions.

Pentagon's leading Process Safety Performance Indicators (PSPIs) are subject to board review every month.

The goal of *no major personal accidents or plant incidents* is a foundation stone and ongoing group strategy.

At a business level, the site leaders or General Managers, are compelled to "walk the talk" through high profile leadership and interaction with the workforce. Numerous examples of ownership of process safety improvement at the coalface have emerged as a result.

Directors are visible and pro-active members of Site safety committees.

Annual, group-wide improvement plans are agreed with the CEO. A key feature is integrated management systems and implementation of best practice across the group.

Board and group objectives are cascaded to site executive teams and their respective departments.

The company's expectation on individuals' roles and responsibilities is articulated through their job descriptions and personal objectives.

Pentagon's Process Safety Improvement plan is group-wide, and reviewed and revised annually. The plan incorporates lessons learned and reported by others such as the Baker Panel Report into the Texas City Refinery disaster, and the UK's Health & Safety Executive's report into the Buncefield oil depot. Key elements are: organisation and process safety leadership, corporate oversight, hazard & risk assessment, plant integrity, process safety awareness and competence, supervision and monitoring, PSPIs, audit and corrective action.

Staff training and competence assurance on process safety

Process safety awareness training has been completed across the group for Site Safety Committees and senior managers.

The Competence Management System at Pentagon is aligned with the chemical process hazards and risks, and is based upon an understanding of the HAZARDS and CONSEQUENCES for all chemical processes. Process safety competence for front line staff is based upon a solid awareness of the SAFEGUARDS and, most importantly, what controls operators are responsible for to ensure there are no plant incidents. This forms the basis of the operator **Process Safety Essentials** training module for all processes. This, coupled with **Technical Training, Plant Operation, and Analytical Testing** modules, forms the core training package for each process at Pentagon.



After training, operators are assessed to confirm competence. Training and assessments are recorded and entered into visible matrices, where trained status is readily retrievable. Re-assessment is carried out periodically. Training and assessments plans are drawn up for all operators and these are aligned with the annual employee appraisals.

Patterns of work are key to enabling effective training at Pentagon. A six shift pattern and a system of training days have proved popular and effective vehicles for implementing process safety training across the group (as well as other important business driven training).

Community Outreach initiatives

Educational Initiatives

We recognise the importance of industry contributing to educational initiatives both at higher educational level, and in providing a dialogue with the emerging generation of school children and youth. Not only have we assisted in funding important research at universities but we have also supported a number of schools projects.

Catalyst Museum – Industry Week

In the last two years Pentagon is proud to have sponsored and participated in events at the Catalyst Museum. Located in Widnes and aimed primarily at engaging children of school age the museum is the only centre in Europe devoted to chemistry and how the products of chemistry are used in everyday life.

Work Experience

Through our Halebank site work experience placements are provided for local schools. This gives pupils a chance to see what it is really like in the world of business. In addition, university students studying chemistry and engineering subjects are offered placements with us for short term and one year sandwich courses.

Children Challenging Industry Programme

Groups of children are taught by specialist teachers about the interdependency of industry and the environment. For example, topics such as water usage are reviewed and site visits arranged to demonstrate how water is used as part of the industrial process for providing steam, for cooling and in the product itself.

Further education

Pentagon recently welcomed a group of *Applied Science and Forensics* under-graduate students and their tutors who visited the Halebank site to appreciate how theory is turned into practice. They were shown what we do in the laboratories, plant, workshops and offices. We explained how we are organised and what career opportunities the chemical industry can offer.



Young employees and Responsible Care

Pentagon's young recruits are rapidly integrated into the business and are given every opportunity and encouragement to become pro-active members (and leaders) of key business teams. Pentagon has achieved a competitive advantage through a strong, multi-disciplinary Product Improvement Team model with the goal of increasing output, improving raw material conversion efficiency, reducing accidents, reducing solvent usage, improving energy efficiency, and reducing water consumption. Where appropriate, customers are integrated into these teams.