Project Case Study: Implementing a New Odour Control System for a Large UK Pet Food Manufacturer

October 2022[1]

Introduction

In 2021, ERG completed the supply of a new odour control system for a major pet food manufacturer in the UK. This case study describes ERG's role in the project, our technical, construction and project management solutions to the various project challenges, and the key factors involved to make the project a success.

ERG's client is a well-known, international brand with pet food sales in Europe topping £40M per week. The site where this project was implemented is a major manufacturing facility for semi-moist cat and dog food (kibble) and an important contributor to these Europe-wide sales.

Our client rightly cherishes their reputation for the highest standards of social and corporate responsibility and, as a major employer in the area, wished to ensure the odour from the site was consistent with the best standards in the industry. And so, when the emissions from the site became the subject of serious discussions with the EA and local council, they naturally took steps to address the problem.

ERG's contract was approximately £4M for the design, supply, installation and commissioning of the total scheme, comprising three separate odour control systems on the site. Design commenced at the end of 2018, with the site works running during 2020 and 2021.

One of three new odour control systems on the site ("system 1"): two parallel streams, chemical scrubbers followed by carbon filtration. Package includes access steelwork, chemical storage/dosing, ductwork, stack, MCC and controls

[1] Paper presented at AquaEnviro conference "Practical Experiences of Odour Management", October 2022, by Richard Hanson, ERG Managing Director.

Developing a solution to the project challenges

ERG worked with our customer for a number of years prior to implementing the design and build project described in this paper. We provided a series of FEED (front end engineering design) studies to assess options for how best to tackle the problem of odour control on the site, carried out a pilot trial, and gave expert advice on the technology chosen to help our customer answer questions from the Environment Agency (EA).

During this period, our customer carried out olfactometry testing to assist with generating their specification and used a consultant to draft their EA submissions, as well as in-house optioneering studies on the upgrade and repurposing of various of their production lines to match business planning objectives.

ERG's role throughout was to help our customer demonstrate to all the project stakeholders that the technical solution being proposed was fully compliant with the project objectives: improved odour emissions from the site for the benefit of the site's employees and neighbours, compliance with EA requirements and the customer's strict health, safety and environmental specifications, and value for money.

As we shall see in the next section, the process selection required some considerable iteration. But to arrive at a final design, the practical implementation of this technology also needed careful consideration and programming to minimise the impact on the site's production. Our final design took all these aspects into account in an elegant, integrated solution.

Process Selection – matched to the pollution challenge

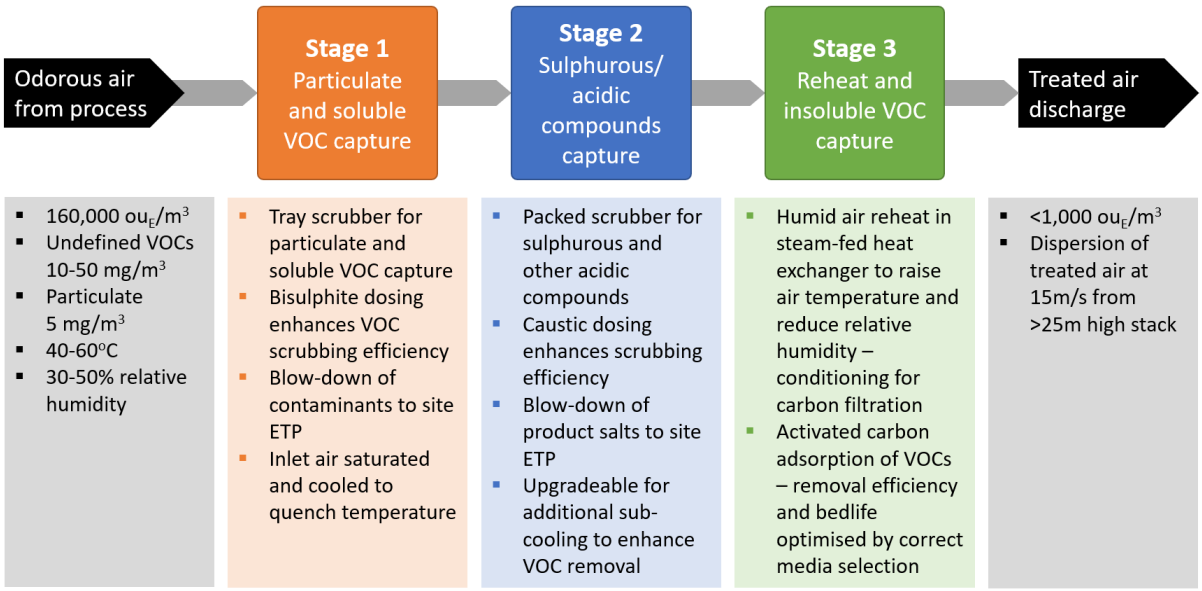
As with most odour control applications, the odour is complex and not fully defined from a treatment perspective. Olfactometry testing gave a design inlet odour challenge of 160,000 ou_E/m^3 and the discharge standard was 1,000 ou_E/m^3 at the stack to achieve the EA's boundary requirements based on the dispersion model, but the odour causing compounds were not defined and so the treatment scheme needed careful consideration. The ideal treatment approach was further complicated by uncertainty about the operating temperature and humidity at the odour control system (OCS) inlet.

In 2008, ERG had supplied an OCS upgrade at a competitor pet food company using a similar kibble production process. In both the 2008 case and for this customer, the new OCS replaced a failing plasma system which was not adequately handling the odours.

To give confidence to all parties, we carried out OCS pilot trials at the site in 2015/6 which confirmed the viability of the process selection for this customer's production odour emissions. And in consultation with the customer, we developed the selected odour treatment scheme further to match all the anticipated contaminants and finalised the BAT (Best Available Technology) selection for the odour treatment. The extracted air was agreed to contain a cocktail of soluble and insoluble VOCs and sulphur-based odorous compounds, together with entrained particulate which swells and becomes difficult to handle on contact with water. The inlet temperature and humidity were also agreed at 40-60^oC and 30-50%RH.

The odour treatment scheme is a multi-stage combination of chemical scrubbing and activated carbon adsorption, summarised as:

- **Stage 1** remove entrained particulate and soluble VOCs – bisulphite dosed tray scrubber
- **Stage 2** remove sulphurous/acidic odours – caustic dosed packed scrubber
- **Stage 3** reduce the air relative humidity and remove insoluble VOCs – reheater and activated carbon filter



The period between 2015 and 2018 involved a great deal of iteration of the technology selection and implementation approach (see the next section). This included investigation by ERG of:

- the merits of reheating using steam (which required a new site boiler plant) or electrical power – steam was the preferred option and the customer upgraded their boiler plant
- the advantage of subcooling the odorous air in the scrubber (prior to the reheat and carbon) in order to minimise water, chemical, steam and activated carbon usage at the expense of additional equipment and electricity consumption – the capital and operating cost analysis by our customer concluded that sub-cooling did not offer a clear advantage within the project payback period and so this was not implemented
- the benefit to the project of re-using two separate, existing wet chemical scrubbing systems on the site – one larger unit was at the end of its working life and so ERG removed this to free-up space for a new OCS; and ERG upgraded a second, mothballed unit as part of the overall scheme
- optimisation of the carbon type – the targeted VOC removal efficiency, lower carbon footprint and lower overall operating cost of regenerable activated carbon proved to be an advantage over impregnated (particularly copper) carbon

As part of the technical design, ERG considered the usual safety concerns associated with handling chemicals in a plant of this type, legionella, activated carbon fire safety and use of steam. Our design limits the risks of all these hazards.

Engineering and design – fixing the new odour control systems to the flow and space available

ERG's customer runs several production lines in their facility, generating a total of 285,000 m^3/hr of odorous air. Due to the location of these lines in the building, space availability for the odour control equipment, and the layout of existing ductwork and control panels, ERG designed and installed three separate OCSs to treat the odorous air (described here as systems 1, 2 and 3).

The new main odour control system (system 1: 160,000 m^3/hr) was to be installed in a compact area previously occupied by some redundant tanks and a currently operating (though rapidly failing) chemical scrubber. This scrubber could not be removed from service until alternative odour control provision was operating. A second main odour control system (system 2: 80,000 m^3/hr) had to be installed on a purpose-built raised platform above an access route between two buildings on the site as there was no available space at grade. And the third, smaller system (system 3: 45,000 m^3/hr)

made use of a 2-stage chemical scrubber supplied by ERG in 1998 which our client had subsequently mothballed.

System 1 comprised two parallel streams of equipment each treating 80,000 m^3/hr air, and system 2 was then a further stream of the same-sized equipment. This yielded design and manufacturing efficiencies for the scrubbers and carbon filters which we passed to our customer as time and cost savings. Because of space constraints, we designed the tray scrubber and the packed scrubber within the same vessel (3.3m diameter * 11.5m tall), with a total of three of these vessels installed (two for system 1 and one for system 2). Similarly, the system 1 and 2 carbon filters had the same design (3.9m diameter * 10.0m tall; two vessels for system 1 and one vessel for system 2). System 1 was all new equipment; while system 2 re-used two existing fans and the original plasma system stack, so minimising the capital expenditure and construction disruption.

System 2 installed on a platform at 5.5m level. Reheater and carbon filter visible with scrubber vessel behind

Swapping old for new – getting it built in the downtime

As part of the OCS upgrade, ERG's customer also carried out phased upgrade work on their production lines (grinders, mixers, granulators, conveyors) which was timed to match the OCS upgrade implementation. The overall programme for these works also considered the competing requirements to maximise production (ie minimising downtime on as many production lines as possible) and carry out removing redundant equipment and casting new civils for the new OCSs, while maintaining odour treatment to at least the standard of the original odour control units.

Working with our customer and their civils contractor, ERG devised and implemented the following plan which achieved all of these ambitious objectives.

- **Phase 1 – strip out redundant tanks and install initial equipment**
  Some redundant tanks were removed, and temporary pipework supports fitted to allow for phase 1 civils to be cast. ERG then installed the new carbon filter for system 3 and the new stack and one new fan, reheater and carbon filter for system 1. This partial system 1 equipment was connected with temporary ductwork and commissioned to provide temporary odour control during the construction.


System 3 carbon filter installed during phase 1

- **Phase 2 – upgrade existing system 3**
  We modified the 1998 ERG scrubber to suit the new design flowrate and bisulphite and caustic chemical dosing and control, and installed a new fan, reheater and ductwork to the new carbon filter (fitted in phase 1) while retaining the original discharge stack. System 3 was then completely commissioned and put into operation. System 3 is inside the building and the new equipment was fitted in a roof space with restricted access, needing all the equipment items to be designed and fabricated suitable for awkward manual handling into position.

System 3 demister and steam-fed heater prior to carbon filter

- **Phase 3 – getting ready for system 1 and installing system 2**
  With system 3 and part of system 1 operational, ERG removed the old main scrubber and the civils contractor cast the concrete plinths and bunds for the rest of system 1. At the same time, our customer installed the system 2 steel platform (which was integrated into the adjacent building's structural columns) and we then installed the system 2 scrubber, heater and carbon filter onto this steel platform, together with the pipework, ductwork and new control panel and cabling. We partially commissioned system 2 to further enhance odour treatment from the site during the construction phase.

- **Phase 4 – installing the rest of system 1**
  The final installation phase saw ERG install the rest of system 1 comprising two scrubber vessels and their tanks, pumps and pipework, the chemical storage and dosing equipment, a further fan, reheater, carbon filter and interconnecting ductwork, the remainder of the access structure, together with a new control panel and cabling. System 1 was then commissioned as a complete system.

- **Phase 5 – final connections, system commissioning**
  The final step was for ERG to complete a number of temporary connections in the ductwork and chemical dosing, change out the system 1 carbon from phase 1 (which had been treating the full odour load) and recommission the complete scheme to optimise performance.

System 2 ductwork installed at 8m above grade

Throughout the installation programme, we worked extremely closely with our customer to ensure the programme was achieved and changes agreed to suit both parties. ERG was the appointed CDM principal contractor for several phases of the work and there were no lost-time accidents, testament to the rigorous safety management of ERG's site team and careful planning and execution of all tasks, including several complex crane lifts and millimetre-perfect installation of some of the equipment in cramped spaces.

New system performance – did it work?

We completed commissioning and training in mid-2021 and our customer has been successfully operating the systems since then. Notably, odour complaints from the site have stopped.

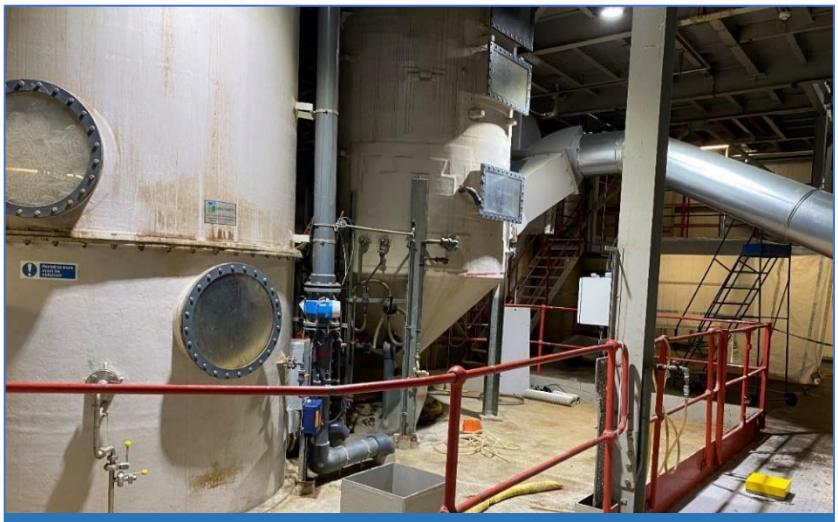
ERG's customer performed third party olfactometric testing of the three OCSs during March, April and May 2022. The data is summarised below and shows that each OCS is achieving the discharge limits required.

Odour control system	Inlet odour ou_E/m^3		Outlet odour ou_E/m^3	
	range	average	range	average
1	900 to 1,200	1,050	300 to 450	400
2	500 to 2,150	1,130	200 to 600	350
3	900 to 2,100	1,300	400 to 700	570

The inlet odour load to each of the odour control systems is significantly below the design value. Our customer thinks that this is due to the enhancements they made to the production lines. The inlet air flowrates are consistent with design values although system 2 is running around 10°C hotter than design which has an impact on the system performance and operating cost due to reduced carbon bed life, albeit at reduced odour loadings.

Factors for success

In ERG's opinion, making a success of complicated odour problems like the one described here involves the following factors.



System 3: original 1990s ERG system refurbished and upgraded for the new duty

- Choose the right team with the combination of technical and construction skills and the ability to plan and carry out the work to cause as little disruption to production as possible
- Use a technology expert with knowledge of real-life operating parameters for design and operation, who can offer a credible performance guarantee backed by experience and technical assistance to support discussions with regulators and internal stakeholders
- Employ a specialist contractor to perform process selection, give manufacturing efficiencies, and manage the constructability of a fully integrated design
- Early engagement – this project benefited from FEEDs and pilot trials. It would not have worked smoothly if a consultant had simply written a specification for suppliers to bid against.

ERG is proud to be a technically expert, trusted contractor capable of successfully delivering this type of large, complex project.

More information from

ERG (Air Pollution Control) Ltd
Bridge House Lane, Five Oaks Road, Horsham, West Sussex, RH13 0QW
www.ergapc.co.uk tel: 01403 290000