Benefits of Long-Term Maintenance for Waste and Energy Minimisation and Process Optimisation

June 2021[1]

Introduction

This paper describes the advantages for Water Companies of long-term engagement with an OCU (Odour Control Unit) maintenance supplier who can identify changes in the process set-up and operation of OCU systems to minimise process upsets, nuisance odours and waste. The paper identifies a number of "hidden" consequences of inadequate OCU maintenance and briefly explains a case study where ERG carried out process optimisation and energy minimisation reviews and subsequently implemented simple system modifications to improve the effectiveness and reduce the operating cost of an existing OCU.

Benefits of Long-Term Maintenance

The benefits of preventive maintenance on mechanical and electrical equipment are well-known and do not need repeating here. The impact of planned and proactive maintenance on the efficiency and operating cost of a complete OCU system is less easy to spot and can be dramatic.

Failure to act in time can lead to serious problems for the ventilation of a Works or process with associated Health and Safety risks, premature failure of the OCU and increased odour nuisance complaints. And when this happens the un-programmed shutdown time and inconvenience, additional expense hitting stretched operating budgets, waste and additional energy needed to return the system to operation can be significant. Examples of preventable system failures include:

- Media blocking (photo 1) leading to reduced air extraction (due to high pressure drop) and scrubbing efficiency (due to poor gas liquor phase contact area). A "minor failure" on a water softener was ignored and then forgotten about – the softener was bypassed to continue make-up to the scrubber. But the hard water reacted with the scrubbing solution to cause scaling which accumulated undetected in the packing over months and eventually the tower section needed to be removed and replaced it was not possible to clean the media.
- Ineffective irrigation liquor distribution in a bio-trickling filter due to partial nozzle blockage – leading to gas bypassing in the

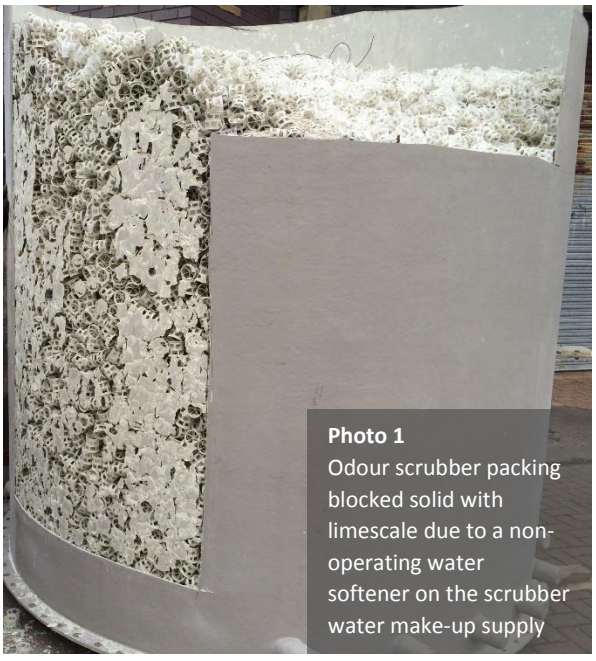

Photo 1
Odour scrubber packing blocked solid with limescale due to a non-operating water softener on the scrubber water make-up supply

[1] Paper presented at AquaEnviro on-line conference "Practical Experiences of Odour Management", June 2021, by Hamish McWillie, Director of ERG APC Maintenance Ltd.

unwetted area and reduced odour scrubbing in the biofilter. This in turn increased the H_2S load onto the polishing carbon filter and premature exhaustion of carbon media.

- Reduced extraction from processes leading to increased H_2S within buildings and around tanks causing corrosion of
  - electrical components (particularly contacts, see photo 2) resulting in serious overheating damage to equipment,
  - steel components (such as tank lids, photo 3) resulting in loss of odorous air containment and unsafe structures,
  - safety elements (for example earth bonding, photo 4) resulting a compromise of the original electrical safety design, and
  - concrete

  In these cases, the building odour levels were not high enough to raise concerns, but the resulting H_2S corrosion has a significant impact.

Photo 2
MCC fuses blackened by H_2S exposure giving increased resistance and "hot spots"

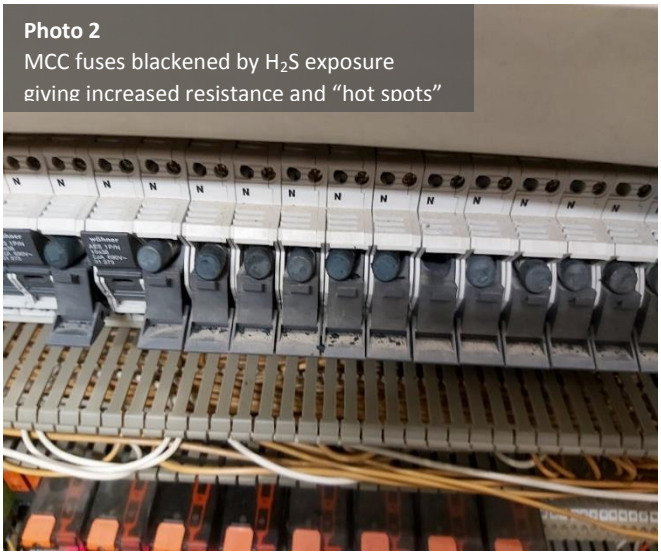

Photo 3
Tank lid and access platform accelerated corrosion caused by extraction duct failure

Photo 4
Earth bonding corrosion

For complete OCU systems, well-managed maintenance includes some of the following aspects. ERG's experience is that these potential problem areas are best identified and remedied by a long-term knowledge of each particular site and OCU system. And had these steps been followed, the damage, odour complaints, waste and cost seen in photos 1-4 could have been avoided.

- **Understanding the original design** – including flow and pressure profile, at the OCU and throughout the ductwork network including at individual extraction points
- **Confirmation that original design is still being met** – in ERG's experience this is best achieved by a periodic (ideally annual) flow survey. On larger OCUs drawing from multiple extraction points, the ductwork can easily become imbalanced resulting in poor extraction from other areas. Examples of how this happens include:
  - Operations staff may open dampers fully if they perceive more extraction is needed in a particular area, starving other areas
  - Solids accumulation leading to blocked ductwork or grilles, and
  - Broken or disconnected ducting
  - Flooding or collapse of underground ductwork

- **Recording trends in stage efficiency** – measuring and recording changes in the removal efficiency of odour across stages including biofilters, carbon filters and scrubbers helps to identify potential problems with the system effectiveness. Portable H_2S and VOC monitors and gas-tubes allow for snap-shot readings to establish performance versus design.
- **Media inspection** – checking the condition of the media helps identify looming potential problems – including media depth, irrigation pattern, blockage, etc.
- **OCU package health checks** – including not only the individual equipment items, but also the implications for the complete OCU operation if certain items are left unfixed.

Opportunities for Process Optimisation

ERG's experience is that system modifications are frequently made for good reasons, without the impact on the overall OCU operation being assessed or adjusted for. Engaging with a specialist OCU maintenance company during these changes can ensure the OCU is properly optimised to treat the odorous air – maximising the efficiency and minimising both the normal operating utilities (power, water, chemicals, etc) and the impact of system failures. A few examples of the type of modification which lead to OCU maloperation, waste and damage include:

- New ductwork added and no rebalancing undertaken
- Redundant equipment/tanks being unnecessarily extracted
- New/replacement process equipment installed with different air inlet configuration causing short circuiting of air flows
- Increasing extraction for specific processes due to changing demands.

Waste and Energy Minimisation Case Study

The following case study describes a contract which ERG recently completed. Our customer is a UK Water Company and our scope was a targeted assessment across 14 sites to identify opportunities for energy minimisation and process optimisation. At each location, a site survey and report was commissioned to investigate increasing air extraction from the buildings for Health & Safety reasons by either optimising the existing system or increasing the OCU capacity.

The findings of the site surveys and report have been implemented initially at a single "flagship site" to demonstrate the effectiveness of the recommended measures. The flagship site's odour-related characteristics are summarised below – these are the reasons it was selected to be the flagship site.

- In common with many similar sites, the flagship site has a significant amount of high odour producing sources operated within enclosed buildings (sludge thickeners, tanker import reception and imported sludge screens)
- The plant was installed in 2008 and had largely reactive maintenance carried out
- The buildings were re-designated as hazardous areas during 2019 as personnel gas monitor alarms activated 3 times over a 6-month period, requiring escape breathing apparatus to be carried.
- Corrosion to control panels and equipment was becoming an issue
- Process optimisation was the key driver for this project with the added requirement to minimise the energy consumption on the OCU 75kW fan to help meet the client's environmental commitments.

At the flagship site, ERG's survey found that:

- The high odour sources had no flow due to one section of underground ducting being flooded or collapsed.

- Another section had failed due to mechanical damage which was not readily visible – ERG determined this by flow and pressure measurements
- All high odours (from the thickeners, screen, etc) were therefore not extracted to the OCU and instead were vented directly into the buildings causing the high number of odour alarms. This additional odour load was removed by general building extraction, which was designated a low odour source in the original design, and so at the OCU this air bypassed the biofilter and went straight to final carbon filter – this resulted in accelerated carbon consumption.

As a result of the survey report, ERG has implemented changes with the following beneficial effects:

- **Reinstatement of effective high odour source extraction**
  - ERG replaced the ductwork which resulted in an immediate improvement in the atmosphere in buildings. The client is monitoring the improved building air quality with a view to allowing normal access.
  - The previous 2mg/m^3 average H_2S concentration within the buildings is now less than 0.2mg/m^3. This equates to a reduction of about 36 kg/month of H_2S passing directly to the carbon filter, doubling the carbon media life from 1.5 to 3.0 years, saving the disposal of 3,000 kg/year of spent carbon media to landfill and saving approximately £6k per year in media costs (excluding the cost of disposal and labour for the media change).
- **Energy minimisation measures**
  - With the building air quality now improved, the air change rate within the building is being reduced during periods of non-occupancy. During the working week, 4 air changes per hour (ACH) are maintained as per the original design, but at night and weekends, this is reduced to 1 ACH. The high odour source extraction rate remains unchanged.
  - To achieve this, ERG has installed new automated dampers and instrumentation and the client is installing variable speed drives for the OCU extraction fans and associated control to ERG's specification.
  - Once this "night/weekend mode" is working, the OCU power consumption will reduce by over 40%, saving 4,500 kWh per week or £23k per year (at £0.10/kWh) which is an investment payback period of 3-4 years.

Summary

ERG has found that continued multi-discipline servicing of OCUs, including a proper understanding of full process intent, is the most of effective way to ensure the odour control system works optimally and keeps in step with changes to site conditions and operations over time. And inexpensive, targeted process optimisation can deliver benefits for the Water Companies by

- Identifying energy minimisation opportunities
- Reducing carbon and waste costs and consumption
- Reducing water and chemical consumption

For more information about OCU maintenance, process optimisation, waste and energy minimisation, visit www.ergapc.co.uk/erg-maintenance/ or contact:

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