CIWEM
The Chartered Institution of Water and Environmental Management

Odours - What a Nuisance

Regulation and Quantification of Environmental Odour

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THE DEATH OF NOOBB?

Steve Fraser, Principal Consultant , RPS Consultants, Edinburgh

INTRODUCTION

This paper considers current approaches to odour control within the UK's Planning and Pollution Prevention and Control regulatory systems. At present there is no uniform method for quantification, or impact assessment. The background, advantages, drawbacks and limitations of the different techniques are discussed and illustrated with several case studies. The use of quantitative techniques is advocated, but only where this approach would provide significant benefits where compared to subjective standards.

Case Study 1 considers the impacts from a fish processing plant which ran into difficulties with the regulator due to poor maintenance and process supervision.

Case Study 2 examines the impacts from an animal rendering plant which successfully upgraded the odour treatment at the works, as a means of obtaining permission for a planned expansion.

Case Study 3 looks at an animal feed plant, gradually surrounded by housing which is subject to increasing pressures from the regulator to reduce odour impacts.

Case Study 4 reviews an assessment for a WWTW process and considers how the planning conditions may have been more appropriately framed.

These examples include odour contour plots using site specific met data, based on the annual 98%ile of 1 hour averages in OU_e/m^3. The model used in all cases is ADMS 3.1.

PLANNING & ODOUR REGULATION

The planning system has developed over the last 50 years, with guidance on planning conditions evolving through experience at inquiry and legal test cases. In the last decade, the Urban WasteWater Treatment Directive led to the construction of many new WasteWater Treatment Works, (WWTW). Public concern about loss of amenity from these works has obliged planning authorities to consider effective means of regulation. Some authorities have sought to limit the effect of these works through the use of odour limits, usually specified at the boundary, using units expressed as H_2S or OU_e.

Planning Guidance advises that conditions should be: necessary, relevant, enforceable, precise, and reasonable. The case study on the WWTW considers: the options for effective control through the planning system; how this works in practice; and how more effective regulation could be achieved.

IPPC & ODOUR REGULATION

The introduction of IPPC extends formal process regulation to many industries that have a history of odour complaint, from the process itself or industrial effluent treatment on site. Current process guidance notes specify emission limits for particular chemical species, and/or

a general prescription that odour shall not be offensive beyond the boundary fence, as perceived by the Inspector. The use of the *'No Offensive Odour Beyond Boundary'* has some advantages: in practical terms it is enforceable and can be readily explained to a non-technical audience. *NOOBB* has also been tested in law.

In Scotland SEPA took enforcement action against Seed Crushers, an oil seed rape process about 30m from houses after receiving about 4,000 complaints. Seed Crushers argued that the use of the boundary odour condition created an unacceptable degree of uncertainty for its operation because it was based on the perception of a SEPA officer. The Scottish High Court ruled that the condition laid down a standard which was ascertainable, and the officer's view was *a way of verifying, readily but not conclusively, whether the standard has been met.*

In England the Court of Appeal dismissed an application challenging Guidance for animal rendering which required emissions to be free from offensive odour beyond the site boundary. The UK Renderers Association claimed that an odour boundary condition had nothing to do with BATNEEC, but was concerned with the achievement of an objective. However, the court ruled that the odour boundary condition was appropriate.

Despite these rulings, the reliance on a subjective test by enforcing authorities does cause practical difficulties when deciding what level of abatement is Best Available Technique for a process sector or a specific process. Some process operators are discouraged from further investment in abatement, due to the perceived uncertainty in regulation. In the case of the animal feed plant discussed below, the operator was unclear what criteria the regulator would use to determine BAT for this process and how far down the road the company may need to go to abate odour. The question is therefore not should we adopt a more quantitative approach, but what standards would be adopted, and in what circumstances.

Benchmark emission limits should be used where these exist. Where there are no specific benchmark emission limits, then a site specific assessment may be required, using a suitable dispersion model to predict ambient concentrations at the nearest sensitive receptor. The frequency of averaging time and short-term fluctuations can be a source of contention due to lack of knowledge of what is likely to constitute acceptability.

CONCLUSIONS

It may be in the interests of process operators to maintain good relationships with their neighbours, particularly if they want to obtain permission for further expansion. Improving process performance will get the community off your back.

Plant maintenance and housekeeping are important factors affecting odour impact, emphasising the importance of effective process supervision. Sudden change may provoke complaint and attract the regulators attention.

Odour surveys are potentially useful tool for BAT assessment and can help process operators and regulators agree on the need for further abatement and the most cost effective means of such abatement.

In principal, numerical boundary odour standards should be used in preference to subjective assessment, provided: the emission source data is there to support the predictions; and that

the regulator accepts that compliance with the standard can only be demonstrated by dispersion modelling.

The use of quantitative olfactometry techniques for new processes should only be considered where there is a commitment to post planning validation and where this expense can be justified. In some cases the complexity of numerical boundary standards may only create the illusion of control. The use of surrogate boundary standard can provide some protection against loss of amenity. For some works it may be more appropriate to rely on subjective odour controls.

There is no single, simple standard of acceptability, which can be applied across all industrial sectors.

There is insufficient experience in the UK to support the adoption of specific odour criteria.

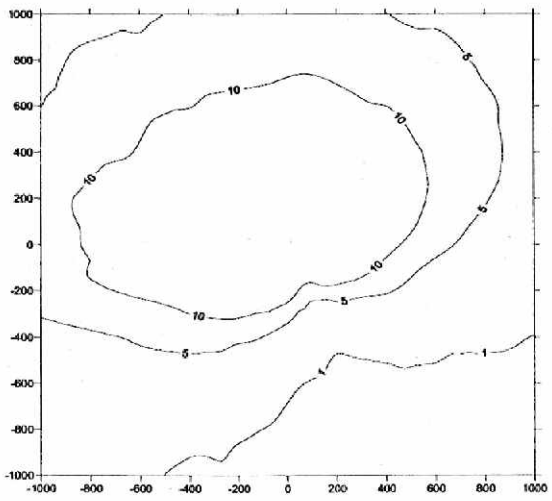
At present it would be premature to kill off *NOOBB*, but the Environment Agencies need to develop benchmark levels for odour control and promote the development and use of objective standards. These should be based on fundamental research into community annoyance and odour.

CASE STUDY 1: FISH PROCESSING

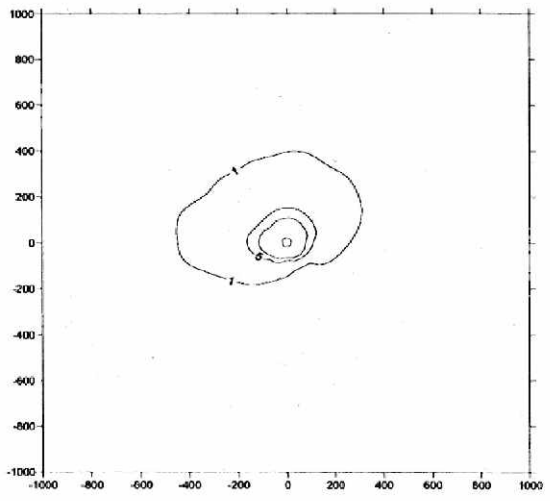
This process is located in a rural area with isolated dwellings within 200m and a village within 750m of the process. The odour is not particularly offensive, but is persistent. The local community were highly vocal in complaining to the operator and the regulator. The main process emissions were treated by a poorly maintained wood bark medium bio-filter with an effective surface area of 370m^2. Large fractures had developed in the bark medium causing short circuits in the air flow. The performance of the filter was further compromised by large fluctuations in moisture and temperature probably reducing bio-logical activity. The bio-filter was designed provide 95% odour removal with a residence time of 60 seconds. In fact, the flow rate was above the design flow, due to subsequent additions to the process gas streams. This reduced the residence time in the bed and increased the inlet temperature. The process also had significant fugitive emissions, exacerbated by poor housekeeping in some process areas. Odour measurements were conducted on the gas stream before and after the filter, following renewal of the medium and maintenance works to the humidification chamber. Based on a visual inspection of the filter bed, at least 25% of the flow was short-circuiting. No measurements were conducted before maintenance to the bed was carried out, so it is not possible to determine the odour concentration on the nearby community before maintenance

	Inlet	**Outlet**
Area	2.4	370
Efflux velocity (m/s)	15.7	.05
Flow rate (m^3/hr)	64,000	
Odour Concentration OU_e/m^3	42,569	1,154
Emission rate (OU_e/s)	759, 571	20,585
Emission rate (OU_e/m^2/s)	2053	56

The process operators have subsequently improved materials handling, and installed additional treatment to control fugitive emissions. The local regulator reports no odour complaints within the last 18 months.



Impact where filter is estimated at 75% removal efficiency (98%ile 1 hour)

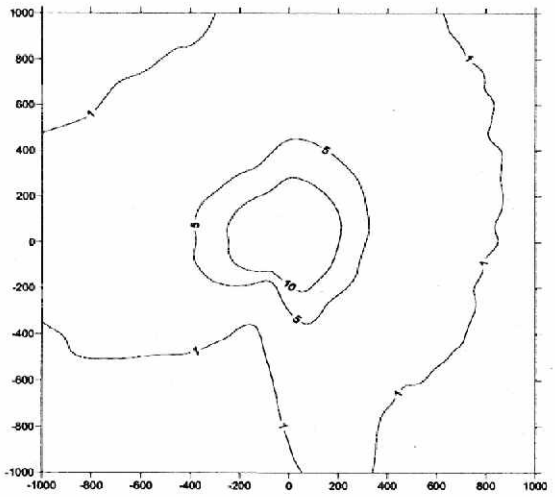


Impact as measured (98%ile 1hour)

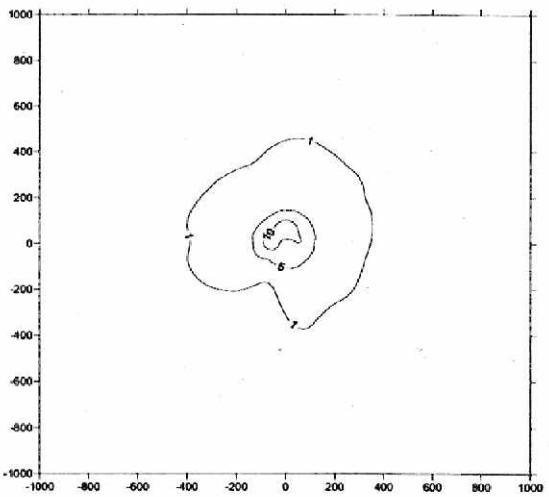
CASE STUDY 2: ANIMAL RENDERING PLANT

An odour impact assessment was conducted at a rural animal rendering plant, as part of an EIA for a proposed extension. The local planning authority raised odour as an issue at scoping stage. The process operator was keen to demonstrate commitment to reducing adverse impacts and improve the prospect of obtaining planning permission. The applicant had previously installed a range of thermal, chemical and biological odour treatment, on an ad-hoc basis as the works had evolved over the years. The most significant pre-abatement sources were: the bio-filter, which received the process gases from the high temperature plant; and the inlet to the tallow fired boiler. The untreated odour from this process is highly offensive. Prior to the tests, there had been a number of complaints, due to changes at the works. The building had been sealed to reduce fugitive emissions. This increased the temperature within the bed, probably severely reducing biological activity. Subsequent tests indicated that the peat medium was performing relatively poorly with about 70% odour removal. The medium was replaced and tests repeated several weeks later. This indicated 85% odour removal efficiency. Process flows through the bio tower were reduced by increasing the flows to the boilers, and replacing the bed with a shell matrix. Subsequent performance tests indicate an odour removal efficiency of 95%.

Rendering Plant Bio-filter	Inlet	Outlet
Area (m^2)	-	225
Efflux velocity (m/s)	-	.06
Flow rate (m3/hr)		11.3
Odour Concentration OU_e/m^3	37,822	11,155
Emission rate (OU_e/s)	425,500	125,500
Emission rate ($OU_e/m^2/s$)	1,891	558



Predicted 98%ile 1 hour as measured 70% efficient



Predicted 98%ile 1 hour with 95% removal

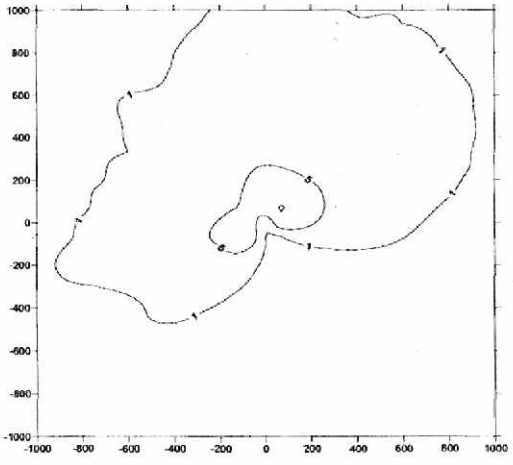
The frequency of odour complaints has reduced to one/two per year.

CASE STUDY 3: ANIMAL FEEDS PROCESS

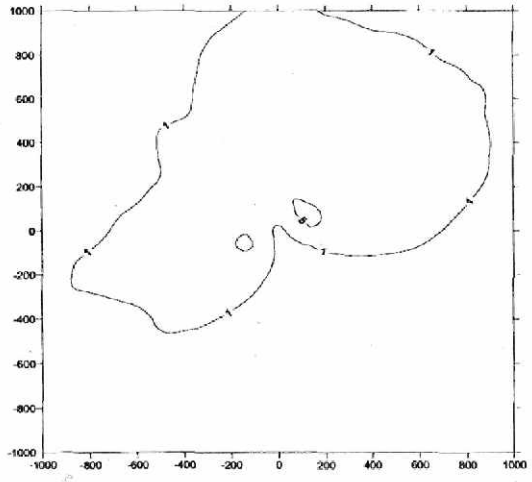
This is a long established process, located in a large town. Originally built on agricultural land, well away from any community, the town has expanded over the years to completely surround the plant. Public acceptance of the process is high, and the odour is not generally regarded as offensive, with a typical biscuit aroma. The process operator is required to submit plans to reduce odour as a condition of authorisation. The local regulator received a high number of high complaints in the last year. These complaints were provoked by poor housekeeping during a planned shutdown, rather than routine process emissions. The process operator has installed primary scrubbing plant with the exhaust used as primary air feed to the boilers. An assessment has been conducted to help demonstrate the effectiveness of existing abatement; to determine if further odour treatment is required; and if so, how odour abatement should be prioritised.

Animal Feed Plant	Emission rate (OU_e/s) Before	Emission rate (OU_e/s) After
Process 1	13,570	13,570
Process 2 (emission to atmosphere)	40,638	5,903
Process 2 (diverted to boiler)		81,426
Process 4	55,129	55,129
Process 5	67,523	67,523

This analysis indicates that the footprint from the process emissions is not significantly reduced for $1OU_e/m^3$ 98%ile. The diversion of the process gases to the stack significantly reduces the $5OU_e/m^3$ 98%ile around the plant. On the basis of the emission rates, these emissions look worse with the abatement, rather than better.



98%ile 1 hour (No abatement)



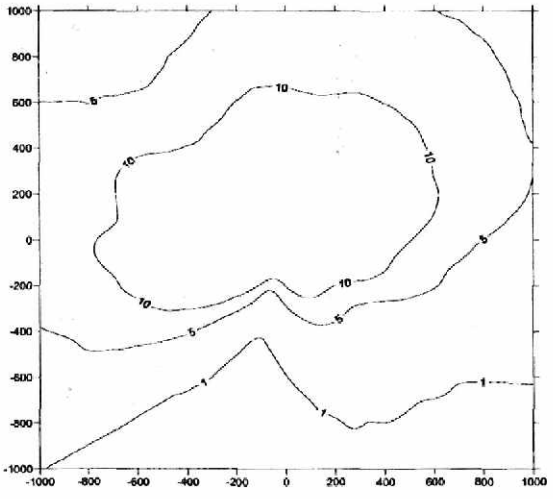
98%ile 1 hour (Current abatement)

When the ground level concentrations are plotted, it appears that the high temperature discharge from the boiler plant does provide some benefit. Process 2 gases are currently scrubbed and passed to the boiler plant. The study indicates that odour footprint from the plant may be reduced by diverting Process 4 to the boiler and Process 2 emissions directly discharged to atmosphere. This is work in progress.

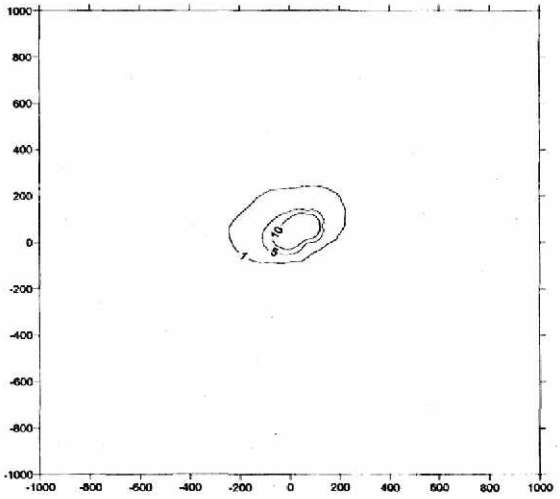
CASE STUDY 4: WASTE WATER

The process under consideration was an upgrade of an existing works with primary settlement, discharging into an estuary. The existing works received a high BOD industrial effluent which frequently turned anaerobic in the summer. The sludge from the primary tanks was also a major source of odour when the holding tanks were being emptied for off-site disposal. The odour from the works was highly offensive and provoked widespread complaints. The water company specified that the works should be designed to achieve $5OU_e/m^3$ annual 98%ile of 1 hour averages. Source emission estimates were based on the STOP model developed by WRC. Roughly the same time, the high BOD industrial effluent ceased discharging into the catchment.

Odour emission rates from processes depend on: the odour potential (OP) and pH; flow over weirs; wind speed across open tank surfaces; velocity and turbulence in tanks and channels; the volume and concentration of odorous gases; and efficiency of odour treatment. This approach relies on accurate quantification of source conditions used to determine emission rates. The source conditions for open tanks are highly sensitive to assumed conditions. Use of different OP values and surface wind speeds could increase odour emission rates by a factor of 30. Details on odour potential are seldom available for new processes. Estimates of OP can be derived from BOD:COD data for the catchment, but OP values should be confirmed as part of the commissioning process. In practice operators are unwilling to incur this expense unless obliged by planning condition.



98%ile 1 hour Before Upgrade



98%ile 1 hour predicted in ES

The planning authority imposed a boundary odour standard $5OU_e/m^3$ annual 98%ile. In practice no quantitative validation of the predictions has been conducted by the operator. Ambient conditions normally encountered beyond the boundary fence can't be measured directly. The complaint record indicates that this process is now acceptable, although there were significant issues during commissioning. In this case, the planning authority may have been better advised to use a subjective standard like *NOOBB* rather than a quantitative approach requiring costly post planning validation and has not proved necessary in the circumstances.