A Comparative Review of SEPA and EA Guidance on the Calculation of BMW Content of Treated MSW

Preamble

The Environment Agency (EA) has published *'Guidance on monitoring MBT and other pre-treatment processes for the landfill allowances schemes (England and Wales)'* (EA, 2005) and it is the intention of the Scottish Environmental Protection Agency (SEPA) subsequently, to review and update its guidance along similar lines. The EA guidance includes reference to two novel tests for the calculation of biological municipal waste (BMW) content of municipal solid waste (MSW). These tests are the dynamic respiration (DR4) test and the biochemical methane potential (BM100) test respectively. SEPA currently suggests the use of the loss on ignition (LOI) test for similar calculations. This report aims to compare and contrast these three tests and to make recommendations regarding which, if any tests SEPA should adopt for their purposes.

Biological Municipal Waste

BMW is that fraction of MSW, which is both biological in origin and possesses the characteristic of biodegradability. That is, it may undergo an autolytic or microbially-mediated digestion to produce carbon dioxide (CO_2) and water or methane (CH_4) and water or a combination of both under varying conditions of oxygen availability. It is the potential for BMW to produce the greenhouse gasses, carbon dioxide and methane that predicates our concern with this material in MSW. This then indicates the need to minimise the amount of BMW that goes to landfill, rather than alternative, controlled treatments that both minimise the production of the gasses and controls their proportion (eg: composting etc).

Critical Review of the Tests

Dynamic Respiration Test (DR4)

This test is designed to assess the biodegradability potential of MSW to carbon dioxide and hence, the BMW content. The test requires statistically randomised samples of MSW to be monitored for their ability to produce carbon dioxide over a four day period. The scientific basis of the test is sound and data yielded would give an accurate indication of the BMW content of the samples tested. However, if the samples were inaccurately or improperly taken, then the test would yield data, which was unrepresentative of the MSW as a whole. The test is technically complex and would require the services of a qualified scientist and significant laboratory facilities. The EA proposed test regime would involve this test being undertaken on newly established processes, monthly on all representative input materials and fortnightly on all output materials (total 36 tests per annum per process). Established processes would then require this test to be undertaken fortnightly on all output materials (total 24 tests per annum per process).

Biochemical Methane Potential Test (BM100)

This test is designed to assess the biodegradability potential of MSW to methane and hence, the BMW content. The test requires statistically randomised samples of MSW to be monitored for their ability to produce methane over a 100 day period. The scientific basis of the test is sound and data yielded would give an accurate indication of the BMW content of the samples tested. The test is based upon a Blue Book method for estimating the biodegradability of sewage sludge by anaerobic digestion (SCA, 1977). However, if the samples were inaccurately or improperly taken, then the test would yield data, which was unrepresentative of the MSW as a whole. The test is technically complex, although less so than the DR4 test, and would require the services of a qualified scientist and significant laboratory facilities. The EA proposed test regime would involve this test being undertaken on newly established processes, monthly on all representative input materials and fortnightly on all output materials (total 36 tests per annum per process). Established processes would then require this test to be undertaken quarterly on all output materials (total 4 tests per annum per process).

Loss on Ignition Test (LOI)

This test is designed to assess the total percentage of organic material present and hence, the BMW content. The test requires statistically randomised samples of MSW to be assayed for their organic matter content by estimation of the ash content after furnacing. This test can be completed in less than 24 hours. The scientific basis of the test is sound and data yielded would give an accurate indication of the BMW content of the samples tested. However, if the samples were inaccurately or improperly taken, then the test would yield data, which was unrepresentative of the MSW as a whole. The test is far less technically complex than either the DR4 or BM100 tests and could be undertaken by a trained and qualified technician in moderately well equipped laboratory facilities. The SEPA proposed test regime would involve this test being undertaken on newly established processes, bi-monthly on all representative input and output materials (total 12 tests per annum per process). Established processes would then require this test to be undertaken bi-monthly on all input and output materials (total 12 tests per annum per process).

Critical Overview

Scientific Basis	All three tests are scientifically sound and are based upon well understood scientific principles. All three tests would yield accurate assessments of BMW content. The percentage accuracies of each test would be similar. However, possible variations would occur as follows: (i) The DR4 test is potentially the least likely to yield repeatable results on similar samples. This is due to the high degree of variability in oxygen uptake of decomposition microorganisms, dependent upon environmental conditions, microbial population balance and the tractable nature of the biological material available. (ii) The BM100 test will yield an accurate estimate of both methane production potential and BMW content. However, this test is time consuming and would take significant investments in laboratory space. (iii) The LOI test will yield an accurate estimate of BMW, but could be skewed by the presence of combustible inerts that are capable of being ashed (eg: plastics). It is possible to mitigate against this problem by judicious removal of plastics from the randomised sample. However, this process is tedious and a better option may be to calculate the percentage combustible inerts of the MSW and

	remove this proportion from the final BMW data.
Statistically Randomised Sampling	All three tests require statistically randomised sampling in order to ensure that the test results are valid.
Time scales	The BM100 test takes 100 days to completion. The DR4 test takes 4 days to completion. The LOI test takes 24 hours to completion.
Technical capacity	The BM100 and DR4 tests would require significant scientific expertise and investment in equipment, consumables and space. These tests would occupy significant laboratory space throughout the testing cycle and could only be undertaken by specialist laboratories. The LOI test could be undertaken by a trained technician with moderate investment in equipment and space and no continuing consumables costs.
Estimated Costs (not estimating set up costs)	DR4 Test approx. £1000 per test. BM100 Test approx. £900 per test. LOI Test approx. £20 per test.

Conclusions

Given the critical review above, I am of the opinion that the LOI test would be the most suitable test for estimation of BMW content on a regular basis. Whilst I cannot doubt the scientific foundations of the DR4 and BM100 tests, their costs of both establishment and operation would preclude their frequent use in an industry where costs are sometimes marginal and scientific competency on-site is patchy. Therefore, I would suggest that SEPA adopts the LOI test in its guidance to operators.

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