Advice Sheet 40: Waste to Land

The recovery of waste and waste-derived materials to land is an important source of nutrients and soil improvers, reducing costs to both industry and land managers. Wherever possible, waste should be recognised as a resource, only being sent to landfill as a last resort. However, it is also important to ensure that the landspreading of waste derived materials does not lead to unacceptable risks to human health, crops and livestock, and the wider environment.

Healthy soils store carbon, produce food and timber, filter water, and support wildlife and landscapes. Soil quality depends on a number of complex and interacting factors including its structure, mineralogy, pH, organic matter and nutrient content, and the presence of diverse and abundant communities of micro- and macro fauna. Recovery of waste and waste-derived materials to land can improve many of the beneficial aspects of soil such as structure, nutrient and organic matter content, and pH. But they may also introduce or increase levels of chemicals in soil that may alter the physical and chemistry of soil, and affect the numbers, diversity and function of organisms.

Waste analysis

Before spreading any waste on an area of land, the operator is required to submit a deployment form to the EA before the activity commences, to ensure their proposed activity will meet the requirements of the rules of the Environmental Permitting Regulations 2010. The operator has to demonstrate to the Environment Agency that a landspreading procedure will convey ecological benefit and is not just a disposal process in order to gain a permit. One of the requirements of the application process is the submission of a recent analytical report of the waste. The decision on what to test for is the responsibility of the applicant, but the EA would typically expect to see:

Nutrients	Nitrogen Phosphate Potassium Magnesium Sulphur
Physical properties	%dry matter % organic matter
Chemical properties	Neutralising value Conductivity pH
Metals (PTE's)	all those set out in Code of practice for agricultural use of sewage sludge
Organics	dioxins PAH's
Pathogens - to demonstrate biologically active waste is sanitised	E. coli Salmonella
Physical contaminants – particularly important in compost to demonstrate material is fit for use	Metal Glass Plastic
Other contaminants	Notifiable disease Noxious weeds
Waste specific analysis	C:N ratio in composts Sodium levels in salty wastes Demonstration of waste stability, e.g. for compost

However, this list is not prescriptive, exhaustive, or a minimum requirement list of what to test for. Analysis requirements depend on the processes and inputs that went into forming the waste. Some of the analysis listed could be considered to be too vague, e.g 'notifiable disease', to be helpful.

t: +44(0)1344 886338 w: www.cawood.co.uk/nrm
NRM, Coopers Bridge, Braziers Lane, Bracknell RG42 6NS

CDA-040-TBA-V2
Issued: 11th August 2021

But in 2017 the EA published 'Derivation and use of soil screening values (SSVs) for assessing ecological risks'. It expanded the coverage of chemicals for which an SSV is proposed to include a wider range of common trace elements and persistent organic pollutants that are relevant to wastes applied to land. Many of the chemicals for which an SSV has been recommended are not listed in the current advice on landspreading deployments. These chemical substances were prioritised as either the Food Standards Agency (FSA) had identified a range of emerging environmental chemicals of concern to the consumer food chain or they were most likely to be found in wastes and waste-derived materials recovered to land, so there is hope a targeted approach will follow and that the 'How to comply with your landspreading permit (2013)' will soon be updated to include the analysis requirements of the various wastestreams, as currently there is confusion within the industry as to what is likely to be required by the EA.

Common Trace Elements and Persistent Organic Pollutants

The direct terrestrial ecotoxicology and potential for secondary poisoning of 38 chemical substances and mixtures (23 trace elements and 15 persistent organic pollutants) were published by the EA in 2017 - 'Derivation and use of soil screening values for assessing ecological risks'. Of these, SSVs were proposed for 9 trace elements and 10 organic pollutants (Table 1). Technical uncertainties, evaluation methodology and unfavourable comparisons with background soil concentrations were the most common reasons for not proposing SSVs for the remaining 19 chemical substances.

SSVs for common trace elements and persistent organic pollutants

Substance	SSV (mg per kg DW)	Added risk	Site-specific adjustment	Driver
Trace elements				
Antimony	37	No	No	Direct toxicity
Cadmium	0.6	No	No	Direct toxicity
Cobalt	4.2	No	Yes	Direct toxicity
Copper	35.1	No	Yes	Direct toxicity
Molybdenum	5.1	No	Yes	Direct toxicity
Nickel	28.2	No	Yes	Direct toxicity
Silver	0.3	No	Yes	Direct toxicity
Vanadium	2.0	Yes	No	Direct toxicity
Zinc	35.6	Yes	Yes	Direct toxicity
Organic pollutants				
Benzo[a]pyrene	0.15	No	Yes	Direct toxicity
Bis(2-ethylhexyl) phthalate	13	No	No	Direct toxicity
Hexachlorobenzene	0.002	No	Yes	Secondary poisoning
Pentachlorophenol	0.6	No	Yes	Direct toxicity
Perfluorooctanoic acid	0.022	No	Yes	Secondary poisoning
Perfluorooctane sulfonate	0.014	No	Yes	Secondary poisoning
Polychlorinated alkanes (medium chain)	11.9	No	Yes	Direct toxicity
Triclosan	0.13	No	Yes	Direct toxicity
Tris(2-chloroethyl)phosphate	1.1	No	Yes	Direct toxicity
Tris(2-chloro-1-methylethyl) phosphate	1.8	No	Yes	Direct toxicity

t: +44(0)1344 886338 w: www.cawood.co.uk/nrm
NRM, Coopers Bridge, Braziers Lane, Bracknell RG42 6NS

CDA-040-TBA-V2
Issued: 11th August 2021

What are SSVs?

It is important to understand precisely what a SSV actually is: a SSV is defined as: '…concentrations of chemical substances found in soils below which there [were] not expected to be any adverse effects on wildlife such as birds, mammals, plants and soil invertebrates, or on the microbial functioning of soils'.

SSVs are 'trigger values' that can be used to simplify the initial assessment of risks to soil ecology and wildlife arising from the long-term presence of chemicals.

SSVs do not represent maximum permissible limits for chemicals in soil. They are indicators to an assessor that soil concentrations above this level may pose an unacceptable risk to soil health and dependant wildlife. The likelihood of an increased risk may depend on:

- The margin of exceedance
- The uncertainty in ecotoxicity data on direct toxicity and secondary poisoning
- The uncertainty in the measurement of the chemical level in soil including the natural variability of chemical concentration and soil properties
- The specifics of a soil ecosystem and the importance of its different soil functions (e.g a soil used for growing crops has different requirements from a soil used to restore land for recreational use)
- Other site-specific factors such as organic matter content, soil texture and pH.

Advice on using these SSVs

SSVs are levels of chemicals in soil below which there is unlikely to be any risk to its health and functions. They cannot and should not be compared directly with the levels of chemicals in a waste or waste-derived material.

Using SSVs to assess the risk from a landspreading or restoration activity generally involves an estimate of the change in soil levels after the proposed recovery to land has taken place. The following information is usually required:

- Pre-existing soil concentration before the recovery activity
- Other relevant characteristics in receiving soils, wastes and waste derived materials including soil organic matter (SOM), Cation Exchange Capacity (CEC) and pH
- Good characterisation data including concentration levels of the chemicals in the wastes or waste-derived materials
- Application rates and/or mixing rates of all materials to be spread or used in site restoration.

Ambient soil concentrations and added risk

Soils contain a wide variety of chemicals from natural and anthropogenic sources. Metals and other trace elements in soil are derived partly from weathering and mineralisation and partly from additions resulting from human activity (anthropogenic sources). Ambient soil concentrations vary from field to field because of differences in local and regional background levels and farming practices.

An accurate soil analysis is essential to assess the impacts of spreading waste to land. Soil samples should be collected and analysed before their deployment. This allows the estimation of the concentration of chemicals in soils after landspreading for comparison with SSVs. Representative soil data may also be required to vary the SSV itself where the added risk applies through its derivation. These example datasets include:

t: +44(0)1344 886338 w: www.cawood.co.uk/nrm
NRM, Coopers Bridge, Braziers Lane, Bracknell RG42 6NS

CDA-040-TBA-V2
Issued: 11th August 2021

- National Soil Inventory for England and Wales (Environment Agency 2006b)
- UK Soil and Herbage Survey (Environment Agency 2007)

The concept of 'added risk' assumes that:

- Natural levels of trace elements have contributed to existing soil biodiversity and function
- Adverse effects are attributable only to additional chemical loadings from anthropogenic sources.

This approach is not without its flaws because an exposed organism will not always be able to distinguish between natural and anthropogenic sources of contamination. For some metals, however, a clear discrepancy in bioavailabilty has been observed between the natural background concentration and the added anthropogenic fraction, and the approach has been accepted for some trace elements.

An SSV based on added risk is therefore the sum of the natural chemical level in soil and the additional component related to adverse effects. In this respect, a reasonable worst-case scenario minimises the background soil contribution (such as using a 10th percentile value from a regional or national dataset or site specific data, where available). For the proposed SSVs listed in Table 1 added risk can only be applied to the SSV for Vanadium and Zinc.

Soil characterisation and adjusting an SSV

Soil is a complex and heterogenous medium, which strongly influences the mobility and availability of chemicals in soil. Results from ecotoxicology tests from which the SSVs are derived have been normalised to remove the inherent variability introduced by soil properties to enable a comparison of the data generated. Almost all SSV values for non-ionic organic chemicals have been corrected to a SOM content of 3.4%.

Applying an SSV requires a correction from the standard soil to site-specific conditions which have been determined by field measurements. In some circumstances it may also be appropriate to consider the predicted changes to soil properties as a result of landspreading (where there is likely to be a significant adjustment to soil pH or SOM).

For a number of common metals a number of empirical relationships have been developed to allow the adjustment of guidance values to soil conditions (pH, SOM, CEC and clay content).

References

ENVIRONMENT AGENCY (2006b) Ambient background metal concentrations for Soils in England and Wales

ENVIRONMENT AGENCY ((2007) UK soil and herbage pollutant survey:Introduction and summary

ENVIRONMENT AGENCY (2013) How to comply with your landspreading permit

ENVIRONMENT AGENCY (2017) Derivation and use of soil screening values for assessing ecological risk

t: +44(0)1344 886338 w: www.cawood.co.uk/nrm
NRM, Coopers Bridge, Braziers Lane, Bracknell RG42 6NS

CDA-040-TBA-V2
Issued: 11th August 2021