Developing Technical Standards for Organic Bio-filtration Media.

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Abstract

The following paper describes the processes and outcomes of deliberations by a Standards Committee of expert stakeholders established to create defensible technical standards for Organic Biofiltration Media. The Standard includes Performance Based Standards (PBS) to establish performance criteria and Performance Validation Standards (PVS) for substantiating performance claims.

The Standards project is supported by EPA NSW as part of the Waste Less, Recycle More initiative and is funded from the waste levy to initiate the use of recycled materials in products used in the stormwater biofiltration sector. Formal collaborators under a Deed of Agreement involved Centre for Organic Research & Education (CORE) and Stormwater Australia.

The Standard sets out performance requirements and methods of validating performance for organic biofiltration media, used in systems to manage storm water run-off in vegetated and non-vegetated systems.

Organic bio-filtration media shall contain a minimum of 25% (v/v) fit for purpose (preferably accredited) organic matter and be made from at least 25% (v/v) recycled materials to support sustainable procurement policies and practices. Harnessing physical, chemical and biological mechanisms and processes, organic bio-filtration media should meet specified performance requirements including treatment of conservative and non-conservative pollutants, manage infiltration rates and support sustainable plant establishment and growth.

The Standard addresses these factors by describing general media characteristics, establishing pollutant removal performance benchmarks, providing measurement for vegetation integrity and setting standards and guidelines for maintenance and monitoring. The Standard also includes principles for sustainable procurement and the increased use of recycled materials in bio filtration media systems. Validation measures include test methods applicable under varying conditions.

Technical Standards for organic biofiltration media provide consistent methods for establishing and validating performance. The project builds industry capacity, changes awareness, knowledge, behaviours and practices around the use of organic bio filtration among stormwater practitioners and influencers including providing sustainable procurement options.

Standards adoption will support the stormwater industry in the rapidly developing green infrastructure policy environment. Internationally organic filter media is being used in landscape features to manage pollutant removal, drainage, hydraulic control (e.g. nuisance flooding), increase verdancy, improve asset life span, resilience and reduce climatic effects. Simultaneously organic filter media is lowering costs through extended lifespan, improved retention (water holding capacity and reuse) and the use of effective, low cost materials.

1. INTRODUCTION

Centre for Organic Research & Education Inc. (CORE) is a not for profit, registered charity operating under a constitution formally registered with the government (Australian Charity and Not for Profit Commission) with the primary activities of collaboration, advocacy, research and education. The majority of members are from the general public.

CORE's charitable purpose is to ensure that the Collaboration, Advocacy, Research, and Education activities continue to serve to educate people about the organic cycle and organic systems. Particular focus is placed on the role of organic recycling, food production and bio-products in providing high quality, healthier and safer organic products, systems and soils, creating the foundation for a more liveable and sustainable environment.

2. ABOUT BIOFILTRATION

Bio filtration is an expanding market solution used in stormwater quality and quantity management (e.g. water retention techniques used to remove pollutants and reduce nuisance flooding). Bio filtration systems are being implemented in Australia and around the world due to their ability to provide cost effective, aesthetic solutions to stormwater treatment and management. Bio filtration is an integral component of the accelerating proliferation of Sponge City Design and Green Infrastructure projects.

Bio filtration contains media systems that support phytoremediation and remove pollutants from runoff water for safer discharge into waterways or to enable harvesting for 'fit for purpose' reuse. Raingardens and bio swales are typical examples where bio filtration media are used. One of these media systems is Organic Biofiltration Systems.

3. ABOUT "ORGANIC" BIOFILTRATION SYSTEMS

Organic bio-filtration systems can meet performance requirements including removal of conservative and non-conservative pollutants, manage infiltration rates and support sustainable plant establishment and growth. Used all over the world in vegetated and non-vegetated systems, organic biofiltration methods are proving to be efficient and effective measures for stormwater runoff management and reuse.

Advanced biofiltration technology includes Organic Biofiltration media systems that use reactive processes incorporating recycled materials to physically, chemically and biologically treat pollutants. Independent laboratory and field testing identifies significant pollutant removal efficacy (Lucas et al, University of Newcastle, 2014, 2016, 2018) and (Recycled Products in Stormwater Treatment Applications, Department of Environment and Conservation NSW, 2006). The media has high inherent retention capacity (i.e. water holding capacity) that can assist in reducing excess stormwater runoff from impervious surfaces and assist in reduction of nuisance flooding.

Life cycle costs also favour organic bio filtration products due to the longer lifespans and increased efficacy (*op cit,* Lucas). Media that uses high proportions of recycled material are also considered a more sustainable option than excavated natural soils or sand. However despite these favourable characteristics and significant international adoption, organic filter media has gained little traction in the Australian market.

Uptake of organic bio-filtration products have been significantly constrained by factors including the lack of technical standards to compare and validate performance claims of any alternative media options available. Because of the lack of Performance and Validation Standards and no observance of sustainable purchasing practices by government authorities, procurement practices in the stormwater sector are favouring virgin excavated sand and soils over products containing recycled materials. In many cases virgin natural resources have been entirely depleted.

4. WHY STANDARDS?

Without technical standards decisions are being made on factors such as price and selective specifications, not necessarily on validated performance, cost effectiveness or sustainability principles. This tends to favour low quality soils without any recycled material content.

Positioning bio filtration media containing recycled materials in the market will require a consistent approach across the stormwater industry to evaluating performance, hence the need for technical standards. The scientifically proven efficacious performance of organic filter media (*op cit*) should ensure that adoption in this market can be realised given equitable technical standards that ensure that products are fit for purpose and perform as expected when in use.

In recognition of the critical need for increasing markets for recycled materials (e.g. China SWORD), together with the expressed need for Performance and Validation Standards in the stormwater sector, funding provided by the NSW Government offered the opportunity to accelerate the development of technical standards for organic bio-filtration media. Consequently CORE co funded the Performance and Validation Standards for Organic Biofiltration Media with the NSW EPA. Consistent with the Stormwater Industry Association (SIA) introduction of industry based standards in distinct areas of Stormwater Quality Improvement Devices (SQIDs), stormwater practitioners are expressing the need for these tools across the sector to enable them to manage their own risk. Due to the absence of leadership by government authorities in this area stormwater professionals are looking to the institutional sector for leadership in developing standards.

5. WHAT IS A PERFORMANCE BASED STANDARD?

"Industry standards must be designed to ensure a consistent measure, norm, or model in comparative evaluations" (Webster's Dictionary).

This innovative industry technical standard includes Performance Based Standards (PBS) to establish performance requirements and Performance Validation Standards (PVS) to establish protocols for substantiating performance claims.

In contrast to prescriptive standards that define physical characteristics, Performance Based Standards can be described as*:

- Emphasising ends over means.
- It is the result that matters, not how that result is obtained.
- Greater emphasis on performance achievement.
- Carried out accurately, reliably, and in a cost-effective manner, they can prove more efficacious than physically based standards.
- The PBS for bio filtration media, for example, includes (inter alia) how much pollutant removal is to be achieved.

Performance Based Standards include*:

- Setting acceptable performance standards - choosing a measuring stick.
- Setting the height of the bar on that stick.
- Practicality and the ease of monitoring compliance - e.g. water quality measurement of influent & effluent.
- Emphasis on the measurement of performance.

Performance Validation Standards include:*

- Setting acceptable methods of performance validation – lab & field based scientific methods.
- Setting the height of the bar - e.g. Achievable methods.
- Independent authentication - e.g. University, literature and peer review.

*Source: Environmental Water Caucus and California Urban Water

6. WHAT'S IN THE ORGANIC PERFORMANCE BASED STANDARD?

The Performance & Validation Standards for Organic Bio-filtration Media defines general media characteristics, establishes pollutant removal performance benchmarks, provides benchmarks for vegetation integrity and sets standards, frequencies and guidelines for maintenance and monitoring. Validation procedures containing test methods under varying conditions are also included. The Standard is designed to provide design and assessment guidelines for specifiers and practitioners including engineers, urban planners, landscape architects, educators and local government.

The Standard sets out performance requirements and methods of validating performance for organic biofiltration media, used in systems to manage storm water run-off in vegetated and non-vegetated systems. Standards of performance and validation of organic bio filtration media systems are provided. The Standard covers the following areas that relate to performance in any biofiltration media system.

1. General Requirements
2. Pollutant Removal
3. Hydraulic Conductivity
4. Vegetation Integrity
5. Maintenance
6. Monitoring
7. Validation of Performance
8. Guidelines for Implementation
9. Environmental Compliance

The Standard defines Organic bio-filtration media as containing a minimum of 25% (v/v) fit for purpose (preferably accredited) organic matter and is made from at least 25% (v/v) recycled materials to support sustainable procurement policies and practices. Organic bio-filtration media effectively supports plant growth and physically, chemically and biologically reacts with pollutant to reduce contamination concentrations in water.

While many of the technical requirements are engineering oriented the development of this standard incorporates the horticultural aspects of bio filtration media into the Standard. This was achieved through active involvement of horticulturists and several Australian Standards (e.g. AS4454) committee members experienced in media and soils standards setting.

The key objectives of the project included:

1. Establish independently developed performance and validation standards for organic bio-filtration media.
2. Specify descriptors that define effective organic bio filtration media system performance.
3. Establish evidence based, consistent and verifiable performance benchmarks.
4. Specify methods and protocols for validating performance claims.
5. Provide performance standards for organic bio-filtration media that ensure they are fit for purpose and perform as expected when in use.
6. Encourage sustainable procurement principles and the increased use of recycled materials in bio filtration media systems.

The desired key outcomes of the project include:

1. Performance and Validation Standards for bio filtration media developed by an independent, multi stakeholder group, published, actively disseminated and adopted.
2. Increased awareness and knowledge about the validated performance characteristics of organic bio filtration and erosion control products.
3. A change in behaviour and practices by stormwater practitioners and influencers towards the use of organic bio filtration products containing recycled materials.
4. Fitness for purpose and validated performance become the basis for which bio filtration media products are selected.

7. MANAGEMENT PROCESSES

Project management processes included:

7.1 Inception

1. Form subcommittee.
2. Develop Terms of Reference.
3. Develop communications plan.
4. Circulation of Expression of Interest (EoI) for standards committee members – SIA Bulletin
5. Process responses to EoI.
6. Finalise standards committee including deed execution.
7. Hold face to face quality function deployment workshop with committee members.
8. Develop document structure.
9. Allocate responsibilities.

7.2 Quality Function Deployment

1. Commence draft standard with input from committee members.
2. Finalise first draft.
3. Issue exposure draft to committee members.
4. Receive and analyse comments
5. Incorporate mutual comments into draft document.
6. Conduct meeting(s) to resolve any anomalies identified.
7. Incorporate final resolutions into the draft document.
8. Construct final exposure draft.
9. Conduct peer review

10. Incorporate comments into document.
11. Publish Standard.

7.3 Consultation & continuous improvement

1. CORE and SIA boards to review governance processes.
2. Conduct independent field studies to refine the standard.
3. Update standard to reflect field studies.
4. Issue updated standard for industry review.
5. Standards committee to review and resolve comments.
6. Issue updated version

8. STAKEHOLDER COLLABORATION

The Stormwater Industry Association (SIA) assisted in forming the stakeholder group of stormwater practitioners to develop technical standards for bio filtration media through the publishing of an expression of interest. SIA brought to this project the experience of having already developed the structural frameworks and governance processes for developing industry standards as part of the development of technical standards for Gross Pollutant Traps. This is part of the SIA's agenda to develop various standards for Stormwater Quality Improvement Devices (SQID's). The SIA is currently developing the business plan for supporting the implementation of their SQID standards following its establishment and publishing.

Drawn from CORE and SIA extensive networks, the working group developed technical standards in response to expressed market needs. This project will create a platform where bio filtration products containing recycled materials can successfully and equally compete, creating a level playing field broadly applicable to all media products to support existing and future manufacturing specifications.

9. RESEARCH BASE

The quality function deployment development of the standards builds on the considerable body of research carried out into bio filtration products containing recycled materials. This includes independent fundamental research carried out in NSW by University of Technology Sydney (e.g. McLaughlan et. al, 2007). Co funded by the NSW Government and CORE, the research clearly demonstrates that the correct compost (i.e. stable, graded) has exceptional efficacy in treatment of pollutants from stormwater and demonstrates other significant performance characteristics. The stable compost used in these studies was obtained from kerbside collected recycled organics that was graded, classified and characterised for use in bio filtration systems.

Since this research exceptional results are identified from numerous other scientific studies (e.g. Lucas et. al) conducted into the characteristics and efficacy of many recycled materials (e.g. glass) combined with many other effective organic and mineral materials to construct custom media formulations. Ongoing local and international studies have already identified over 100 suitable materials that are enabling bespoke solutions to the effective removal of typical water pollutants (e.g. TSS, TPH, N, P, Cu, Pb & Zn) and specific contaminants of concern such as heavy metals including selenium, arsenic and antimony. Current studies also include uranium, percolate (rocket fuel) and pharmaceuticals.

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11. CONCLUSION

Commensurate with the robust scientific evidence identified, this project can change awareness, knowledge, behaviours and practices around the use of recycled products for bio filtration applications among stormwater practitioners and influencers through the introduction of the performance and validation requirements in the Standard.

The benchmark standards contained in the Technical Standards for Organic Bio-filtration Media are to be advanced through appropriate testing in laboratory studies and applicable “test bedding” installations as part of an ongoing continuous improvement process for this Standard. It is accepted that any refinement may vary some of the parameters contained in the initial published version and all feedback will be welcomed and considered. In the interests of having a suitable standard in the market as soon as possible it is considered that continuous improvement is preferable to delayed perfection.

Organic filter media have been shown to remove pollutants from water with very high levels of pollutants such as trade waste water and acid mine drainage. This is considered beyond the scope of this edition of the Standard but may be addressed in future versions as part of the continuous improvement program.

Although considered premature at this stage this Industry Standard may be a precursor to the development of an Australian Standard in the future.

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