TEST PROTOCOL TO DETERMINE THE FLUSHABILITY OF DISPOSABLE PRODUCTS

Report No.:P7696

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Collaborative Project CP: 311

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SUMMARY

I PROJECT APPRECIATION AND OBJECTIVES

An increasing number of household products are marketed as being disposable, some of which are being disposed of via the WC and hence the sewerage system. Some of these products are labelled by the manufacturer as being flushable but there are no agreed criteria for flushability against which these or any disposable products can be assessed.

There is a risk that these products will either cause or contribute to blockage formation, in drains and small sewers particularly with intermittent or low flows. Potentially these products may be discharged into the environment via storm overflows and add to the volume of solid matter removed by the screens at sewage treatment works for subsequent disposal. However some products may not cause any of the above problems and disposal via the sewerage system may be the optimum disposal route when all factors, including public health, are taken into account.

The aims of this project are to:

- Explore and provide a better understanding of the behaviour of disposable products in the drainage and sewerage system;
- Explore consumer attitudes to the disposal of these products;
- Develop the basis for a test protocol to assess whether a product can be considered to be suitable for disposal via the sewerage system;
- Determine whether the situation is likely to get worse in future with increasing use of low water use toilets and domestic appliances.

II RESEARCH RESUMÉ

COLLABORATORS

Anglian Water
Dwr Cymru
Severn Trent Water
South West Water
Southern Water
Thames Water
United Utilities
Consumer Council for Water

DATES

October 2006 to March 2008

RESUMÉ

This report describes the proposed WRc Protocol for assessing whether a product is suitable for disposal via a WC into the sewerage system. The report includes a "Decision Tree" which shows the stages of the proposed WRc Protocol. The Decision Tree follows the potential behaviour of a product as it flows from the WC to the waste water treatment works. Outline specifications are given for each of the tests to be undertaken along with background information and an explanation where necessary of why these tests are to be done.

The proposed WRc Protocol is the result of development work that was undertaken during the 18 month long Portfolio project CP311. This development work is summarised in the final report P7695 and the interim report P7561.

There are four outputs from this project:

- P7561[1]: CP311 – Development of a test protocol to determine the flushability of disposable products – Interim report;
- P7372[2]: Review of the W.E.R.F. protocol to assess the breakdown of flushable consumer products;
- P7695[3]: CP311 - Development of a test protocol to determine the flushability of disposable products - Final report (this report);
- P7696[4]: Test protocol to determine the flushability of disposable products.

In addition the MVA consultancy report *Educating the Public, Research into flushable products*[5] commissioned by the Consumer Council for Water as part of CP311, provides an insight into consumer attitudes on the disposal of products via the WC.

[1] **CP311 – Development of a test protocol to determine the flushability of disposable products – Interim report**, *WRc Portfolio report P7561, December 2007*, A Drinkwater, S Galletti, M Hoblyn, N Tarbet

[2] **Review of the W.E.R.F. protocol to assess the breakdown of flushable consumer products,** *WRc Report P7372, Project CP311, March 2007,* A Drinkwater, S Galletti, N Tarbet

[3] **CP311 – Development of a test protocol to determine the flushability of disposable products – Final report**, *WRc Portfolio report P7695, March 2008*, A Drinkwater, S Galletti, N Tarbet

[4] **Test protocol to determine the flushability of disposable products**, *WRc Portfolio report P7696, March 2008*, A Drinkwater, S Galletti.

[5] An electronic copy of this report has been sent to each member of the project Liaison Group. It will also be available on the CCWater web site, www.ccwater.org.uk from April 2008.

III CONCLUSIONS AND RECOMMENDATIONS

The proposed WRc Protocol provides the basis for a nationally agreed protocol to assess whether products are suitable for disposal via the sewerage system.

The tests require further refinement. The pass/fail criteria and the proposed WRc Protocol need to be agreed by the UK sewerage undertakers, manufacturers of disposable products and policy makers such as Defra and the Environment Agency.

It is known that the manufacturers of disposal products are developing their own test protocol via EDANA and INDA, the European and North American trade associations for non-woven paper products. Although it is unlikely that the requirements of the EDANA and INDA protocol will be exactly the same as the proposed WRc Protocol developed by the CP311 project there is a high degree of commonality in the approach taken by both protocols. It is understood that the EDANA and INDA protocol currently does not address the issue of snagging of products in the drain or sewer but that they are not opposed to considering including this when a suitable test becomes available. The EDANA and INDA protocol is currently confidential so no further details can be given in this report.

IV BENEFITS OF RESEARCH

- Independent test data to enable sewerage undertakers to make a well reasoned and convincing case about what can and, more significantly, cannot be reasonably flushed into drains and sewers.
- Proposed test protocol for sewerage undertakers to refer to when engaging with manufacturers of sanitary products.
- Information to enable sewerage undertakers to engage with local authorities, to produce common guidance to the public on the most sustainable disposal routes.
- Better information for sewer system operators to refer to when explaining to customers the reasons for blockages / the problems of disposing with sanitary products.

1. INTRODUCTION

1.1 Background

Manufacturers in the UK are currently developing ever more innovative brands of toilet paper, biodegradable sanitary towels and colostomy bags, cat litter and some disposable wipes, which are designed to be disposed of via the WC to the sewer. There are also a number of other items which are commonly flushed that are not intended by the manufacturer to be introduced into the sewer system, such as the majority of disposable wipes, cotton buds, disposable razors etc.

There have been a number of drivers behind changes in products and associated changes in disposal habits over the last 50 years.

- The first is changes in household disposal. Many households had open fires or stoves which could be used to permanently and discreetly dispose of sanitary items and other waste.

- The second is the rise in disposable items. Disposable sanitary protection and disposable nappies are now the norm, and the range of disposable items is increasing. Cotton buds, cotton wool and wipes are now used instead of flannels or cloths; tissues instead of handkerchiefs; and razors are now disposable.

The combination of these changes led to a vast number of "disposable" items such as sanitary towels, nappies etc. being flushed down the WC, as the WC is a discreet way of discarding these items. In the 1980s and 1990s there was a backlash against this form of disposal, as many of these items ended up on beaches or in rivers via CSOs and other unscreened outfalls, causing intractable aesthetic pollution. This led to campaigns such as: the "Bag it and Bin it campaign[6]", whose logo is now used on sanitary towel packaging; Surfers against Sewage[7] and Beachwatch[8]; all of whom campaigned for responsible disposal of sanitary products.

However, over the last five years improvements in treatment, screening and solid retention have led to a reduction in recognisable items being found on beaches and in rivers, and the issue now has a lower profile. In addition there is increasing pressure being put on local authorities and hence on the general public, to reduce the amount of rubbish which is sent to landfill. Although the aim of this pressure is to promote recycling, it also has the effect of encouraging disposal via the sewerage system.

For the Sewerage Operator the main problem is that there is currently little knowledge of the behaviour of these products if they are flushed. There is little reliable information on whether

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[6] Bag It and Bin It is a national water industry-led campaign promoting responsible disposal of discarded personal products.

[7] Surfers Against Sewage is a campaign for clean, safe recreational waters, free from sewage effluents, toxic chemicals and nuclear waste.

[8] Adopt-a-Beach and Beachwatch are coastal environmental initiatives organised by the marine conservation society (MCS), involving local individuals, groups and communities in caring for their coastal environment.

they will strand, snag and cause blockages; whether their presence will make blockage clearance more difficult; whether they are biodegradable, what is the current legal and regulatory situation relating to these products. An additional issue is the impact of the increasing use of low water use toilets and domestic appliances.

A clearly understood methodology is required to assess which products are suitable for disposal via the sewerage system. For such a methodology to be implemented, it must be acceptable to all stakeholders including the sewerage operators and the product manufacturers. The issues that need to be considered include the development of guidelines for classifying products as flushable, understanding the correct legal context in the various regions of the British Isles and setting this within the strategic context of the sustainability agenda. These issues are addressed below.

1.2 Guidelines for "Disposable" Products

Currently within the UK, there is no way of assessing whether a product can be considered to be suitable for disposal via the sewerage system. A test protocol has been developed in the USA by WERF[9] and a critique of this protocol is given in WRc report P7372[10]. WRc is advising EDANA (the European trade association for non-woven paper products) and INDA (US based association of non-woven fabric industry), who are also developing a test protocol based upon the WERF protocol. However details of this protocol are currently confidential to the members of EDANA and INDA and the various experts that are advising them.

1.3 Legal Context

The legal context for the disposal of anything other than faeces, toilet paper and consented trade effluent is not clear. The law anticipates that domestic sewage contains waste from toilets, and water that has been used for cooking and washing. The relevant law for domestic waste varies between regions of the British Isles. In England and Wales it is the Water Industry Act 1991 (Section 111), in Scotland it is the Sewerage (Scotland) Act 1968 (Section 46), in Northern Ireland it is the Water and Sewerage Services (Northern Ireland) Order, 1973 (Article 39) and in Eire it is the Public Health Acts Amendment Act 1890 (Section 16).

In general, it is illegal to dispose of anything to the sewer that may cause harm to the sewer, or interfere with the free flow in the sewer. Currently however, there is no objective way of determining whether a product may cause harm to, or interfere with the free flow in, the sewer.

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[9] **Protocols to Assess the Breakdown of Flushable Consumer Products** *WERF Report: Treatment Processes/Systems (Project 02-CTS-7P),* C McAvoy, GA Rece, EL Schwab, BA Nuck, NR Itrich, RC Stark

[10] **Review of the W.E.R.F. protocol to assess the breakdown of flushable consumer products,** *WRc Report P7372, Project CP311, March 2007,* A Drinkwater, S Galletti, N Tarbet.

1.4 Strategic Context - Sustainability

Consumers and sewerage utilities are unsure about the most appropriate route for the disposal of some disposable products. Work by Butler et al[11] has shown that the most sustainable route for disposal of sanitary products is via the solid waste disposal route. However, pressure on landfill sites and from Local Authorities means that many consumers are seeking ways to reduce their solid waste disposal.

Many of the new products on the market claim that the most sustainable route for disposal is the sewer because this means that the residuals can be recovered as fertiliser. These claims are most often made by manufacturers' products that are biodegradable and are aimed at the "green" market. There is however an issue with regard to products that are not contaminated with faeces or other organic matter at the time of disposal and have not broken up when they reach the inlet screens of a sewage treatment works. At this point they will be removed from the screens for disposal in a landfill but they will be contaminated with sewage and also be wet. Hence if these products are to be disposed of by landfill, it would be more appropriate for the disposal route to be directly via solid waste and not the sewerage system.

1.5 Project aims

The aims of this project are to:

- Explore and provide a better understanding of the behaviour of disposable products in the drainage and sewerage system;
- Explore consumer attitudes to the disposal of these products;
- Develop the basis for a test protocol to assess whether a product can be considered to be suitable for disposal via the sewerage system;
- Determine whether the situation is likely to get worse in future with increasing use of low water use toilets and domestic appliances.

1.6 Project outputs

There are four outputs from this project:

- P7561[12]: CP311 – Development of a test protocol to determine the flushability of disposable products – Interim report;
- P7372[13]: Review of the W.E.R.F. protocol to assess the breakdown of flushable consumer products;

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[11] **Sustainable disposal of domestic sanitary waste.** *ASCE Journal of Environmental Engineering,* February, 206-215, 2005. Ashley R., Blackwood D., Souter, N., Hendry, S. Moir, J., Dunkerley, J., Davies J., Butler D., Cook, A., Conlin, J., Squibbs, M., Britton, A. & Goldie, P.

[12] **CP311 – Development of a test protocol to determine the flushability of disposable products – Interim report**, *WRc Portfolio report P7561, December 2007*, A Drinkwater, S Galletti, M Hoblyn, N Tarbet

- P7695[14]: CP311 - Development of a test protocol to determine the flushability of disposable products - Final report;

- P7696[15]: Test protocol to determine the flushability of disposable products, (this report).

It should be noted that the development of the proposed WRc Protocol included tests using a full scale Drainline Rig, which allows for the inclusion of imperfections such as pulled joints and grit that are found in actual drain lines. The tests included in the proposed WRc Protocol have taken into account the needs of the sewerage undertakers and the likely impact of disposable products on the drainage and sewerage system.

1.7 Report structure

This report is one of four outputs from the project and it describes the proposed WRc Protocol for determining whether a product may be considered to be suitable for disposal via the sewerage system. The other two outputs; WRc Portfolio reports P7561 and P7695 detail the test work undertaken in the development of this protocol.

The main feature of this report is a proposed Decision Tree and the proposed specifications for the tests that are carried out at each stage of the Decision Tree. It should be noted that for some tests, provisional pass/fail criteria are given as it was considered that the sewerage undertakers may wish to set these criteria taking into account their operational requirements and other factors such as company policy. The values set for the pass/fail criteria do not change the overall approach so provisional pass/fail criteria are provided to demonstrate how the proposed WRc Protocol could operate.

In addition the underlying logic behind the selection of a particular test is included.

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[13] **Review of the W.E.R.F. protocol to assess the breakdown of flushable consumer products,** *WRc Report P7372, Project CP311, March 2007,* A Drinkwater, S Galletti, N Tarbet

[14] **CP311 – Development of a test protocol to determine the flushability of disposable products – Final report**, *WRc Portfolio report P7695, March 2008*, A Drinkwater, S Galletti, N Tarbet

[15] **Test protocol to determine the flushability of disposable products**, *WRc Portfolio report P7696, March 2008*, A Drinkwater, S Galletti.

2. BACKGROUND TO THE PROPOSED WRcTEST PROTOCOL

2.1 The Decision Tree

The Decision Tree shown in Section 3 of this report forms the backbone of the WRc Protocol. It follows the likely progress of a product through the sewerage system from when it is flushed down the WC to when it finally reaches its final receiving environment.

The proposed Decision Tree provides a practical way to assess whether a product can be considered as suitable for disposal by flushing down a WC. The procedure leads to clear answers, i.e. a product will follow one particular branch of the Decision Tree and be classified as Flushable or Not Flushable. The proposed WRc Protocol overcomes many of the weaknesses identified previously[16] in the WERF Protocol[17], the only currently published procedure for assessing the flushability of a product. In particular, the Decision Tree does not offer the possibility of "cherry picking" from a variety of tests at the same stage, or to consider different pass/fail criteria depending on the route that a flushable is assumed to follow. This more rigid structure contributes to the clarity of the proposed WRc Protocol making it as simple as possible, and therefore more likely to be accepted by all the different stakeholders who will be affected by its eventual adoption.

The proposed Decision Tree focuses on assessing the behaviour of products as they progress through the drainage and sewerage system.

At each stage of the Decision Tree either, a statement, a manufacturer's declaration or a test result is required to determine whether the product can be considered to be suitable for flushing. The requirements for each stage are described in Section 2.2 along with comments on why that requirement has been set. The specifications for the tests that are required are detailed in Section 3.

2.2 The requirement for each stage in the Decision Tree

The pass criteria suggested in the following tests are provisional and are provided as an example of how the proposed WRc Protocol could operate. It is suggested that the sewerage undertakers may wish to amend the criteria as they consider appropriate.

[16] **Review of the W.E.R.F. protocol to assess the breakdown of flushable consumer products,** *WRc Report P7372, Project CP311, March 2007,* A Drinkwater, S Galletti, N Tarbet

[17] **Protocols to Assess the Breakdown of Flushable Consumer Products** *WERF Report: Treatment Processes/Systems (Project 02-CTS-7P),* C McAvoy, GA Rece, EL Schwab, BA Nuck, NR Itrich, RC Stark

Stage 1

Question	Requirement
Is the product likely to be contaminated with faeces or other organic matter?	A statement shall be provided by the manufacturer on the possible functions for which the product could be used.

If a product is not likely to be contaminated with faeces or other organic matter, there is no public health need for it to be disposed of via the sewerage system, hence it cannot be considered as being a flushable product. The reason for the above requirement is that before such a product is flushed down the WC, it is essentially dry (or damp) and not contaminated with sewage but after it is flushed it becomes wet and contaminated with sewage. The ultimately point of disposal for the product in either situation will be landfill or be incinerated. It therefore is more appropriate for the product to go directly for landfill or incineration via refuse collection when it is not contaminated with sewage.

Stage 2

Question	Requirement
Are the product and its constituents safe for the environment?	Manufacturer shall provide a declaration according to the EU TGD, 1996[18]

If the product contains any components which could represent a hazard for the receiving water or soil environments, then it is better disposed of by other routes rather than flushing down a WC.

Stage 3

Question	Requirement
Does the product clear the WC under expected usage and flush conditions?	WC Flush Clearance test.

If the product does not clear the WC then it cannot be considered to be suitable for flushing as this would not be acceptable to the consumer. A further requirement is that the WC bowl must not surcharge up to its rim at any time during the test. This requirement was taken from the WERF Protocol and is included because it identifies a potential risk of the WC overflowing when the product is being flushed.

[18] **EU (1996) Technical Guidance Document** in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulations (EC) 1488/94 on risk assessment for existing substances. Parts I, II, III and IV. Document ISBN 92-827-8011-2. Luxemburg. Office for Official Publications of the European Commission. Technical Guidance Document (1996).

The WC must be WRAS approved[19] and be able to provide a 6 litre flush volume. The WC could be a single flush or a dual flush provided the full flush is 6 litres. This flush volume was selected because the dual flush WC with a 6 litre full flush is the most common type of WC currently being sold. Within the next 5 to 10 years, it is likely that WCs with lower flush volumes, such as 4.5 litres will become more common and it may be appropriate to modify the procedure accordingly.

It may be beneficial to undertake this test as part of the Drainline Tests (Stage 4).

The number or the weight of the products that comprise the sample is specified in Section 3 of this report. This is dependent upon the likely number of the product used per occasion. It also takes into account any manufacturer's instructions on the packaging relating to disposal by flushing.

Stage 4

Question	Requirement
Does the product clear the drainage system?	Drainline Test.

The Drainline Test assesses whether the product is likely to pass through the household drain and private sewer system prior to entering the main public sewer system. This test assesses the likely performance of the product in drains and small sewers where the flows are low in volume and intermittent. A WC as described in Stage 3 is attached to the Drainline Rig, which comprises 1 m lengths of 100 mm diameter pipe with an overall length of approximately 10 m.

The gradient is a significant influential factor in drains and sewers with an intermittent flow regime. The gradient that has been selected for the testing Drainline Rig is a uniform gradient of 1:80. This is the recommended minimum gradient specified in The Building Regulations 2000 (part H)[20] as amended for foul drains of 100 mm diameter pipe diameter.

In order to test the propensity of a product to snag on grit and rough surfaces in a drain line, the Drainline Rig has a 300 mm long section of pipe with 1-2 mm sharp grit attached to its invert (bottom inner surface). It is proposed that this section is installed at least 8 m from where the toilet flush comes in (i.e. 8 m downstream of the head of the line). This distance was selected because in household drains it is more likely that grit will settle out towards the end of the drain, where the force of the flow from a WC flush has largely dissipated, rather than near the head of the drain.

It is proposed that 100 samples are tested due to the randomness in the behaviour of samples when tested on the Drainline Rig. As test experience is gained, the number required for testing may be amended.

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[19] The Water Regulations Advisory Scheme (WRAS) is the UK Water Industry's approval scheme. Products approved by the scheme have been shown to comply with the requirements of the Water Supply (Water Fittings) Regulations 1999. Approved products are listed on http://www.wras.co.uk/Directory/ .

[20] Building Regulations 2000, Approved Document H, 2002 edition, available on-line from http://www.planningportal.gov.uk/england/professionals/en/

There are three possible results from this test, described below.

i) It is proposed that if more than 98% of the product samples tested clear the Drainline Rig then the product is considered to be flushable. The provisional 98% clearance requirement is based on the premise that it is unlikely and unreasonable to expect that 100% of the test samples for a product will clear the Drainline Rig. If only 2 in 100 do not clear the Drainline, this is acceptable as it is unlikely to result in the formation of a blockage in a household drain line or sewer. If the product meets this requirement then it moves directly to the Stage 6 test.

ii) If 90% but less than 98% exit the Drainline Rig then the reason for them stopping is recorded and a further test, the Household Drains Disintegration Test is carried out (see Stage 5 below). The assumption has been made that if between 3 and 10 out of 100 products tested do not clear a household drain or sewer then there is a chance that a blockage could form. However if the product is proven to disintegrate within 24 hours then the chance of a blockage forming is reduced to an acceptable level. If the product meets this requirement then it moves to the Stage 8 test.

iii) If less than 90% of the samples clear the Drainline Rig, then the product fails the test. This is because there is a reasonable likelihood that a blockage would result in a household drain or sewer.

Stage 5

Question	Requirement
Is the product likely to break up in the drain within 24 hours?	Household Drains Disintegration Test.

This test is only carried out if the product does not clear the Drainline Rig in the Stage 4 tests for between 3 and 10 occasions of the 100 tests. The test is designed to assess whether the product is likely to break up in the relatively gentle, intermittent flow and slight turbulence that a product is likely to experience in a drain line. A specific rig was developed to reproduce the above conditions. It consists of a clear plastic flexible 75 mm pipe which is arranged in a circle approximately 1 m in diameter. The pipe loop is attached to a laboratory orbital shaking table whose movement induces a gentle flow in the pipe. Approximately 4 litres of tap water is used as the test media, to replicate the conditions in a partially filled household drain. A product sample is inserted in the pipe and its behaviour is observed during the test.

The proposed pass criteria is that 100% of the sample must pass through a 10 mm mesh sieve. In addition 80% of the product must pass through a 5 mm mesh sieve after 24 hours of testing for it to be considered suitable to move on to Stage 8 of the proposed WRc Protocol. This pass criteria was set because the Environment Agency considers anything bigger than 6 mm in two dimensions as materials polluting the water courses or the sea. Most of the fine screens at the inlet of wastewater treatment works or outlet of CSOs in the UK have a 6 mm mesh, apart from the few, newly developed membrane plants which operate with 2 mm mesh screens. For the purposes of the proposed WRc Protocol, it was therefore considered that preventing anything bigger than 5 mm in two dimensions from passing through the screens would not compromise the operation of treatment works and would guarantee acceptable levels of water course pollution in the event of severe storms.

The 24 hours test duration was chosen because it was envisaged that if the product stops moving along a drain line and fails to start breaking up after one day it is likely that a blockage will start to form as other flushed material builds up around the stranded product.

This test regime is relatively gentle and so it is considered that a product that meets the requirements of this test will also meet the requirements of the tests in Stages 6 and 7 of the proposed WRc Protocol (discussed below). Hence there is no requirement for such a product to be subjected to the tests in Stages 6 and 7.

Stage 6

Question	Requirement
Is the product likely to result in blocking or malfunctioning of a pump?	Pumping Station Disintegration test.

Stage 4 test are subjected to the Stage 6 test.

The Pumping Station Disintegration test subjects the sample to vigorous turbulence in shaken baffled flasks over a 6 hour period. The proposed pass criteria are that 100% of the sample must pass through a 16 mm mesh sieve and greater than 80% of the sample must pass through a 10 mm mesh sieve.

The proposed pass criteria have been set on the assumption that provided the product breaks up within 6 hours into relatively small pieces then it will not cause any problems for the pumps found in sewerage systems.

Stage 7

Question	Requirement
Is the product likely to sufficiently disintegrate in the sewer system such that it will not compromise the sewage treatment plant?	Sewer System Disintegration test.

Only products that pass the Stage 6 test are subjected to the Stage 7 test.

The product is subjected to gentle agitation in shaken plain flasks over a 48 hour period. These conditions are aimed at replicating the average turbulence found in the sewers which convey the product from the household drains to the wastewater treatment works. The time for a product to reach the treatment works largely depends upon the distance from the works and the flow rate in the sewer. Since this time is variable, a 48 hour time period was selected as being a reasonable compromise accounting for both the variable turbulence encountered in the sewer system and the time spent in it.

The proposed pass criteria are the same as in Stage 5: that 100% of the sample must pass through a 10 mm mesh sieve and greater than 80% of the sample must pass through a 5.0 mm mesh sieve. The proposed pass criteria were based upon a screen mesh size of 5 mm for the same reasons mentioned at Stage 5 above. Moreover it has been proved that all

toilet paper samples which were tested in the disintegration tests (representing various types of toilet tissues commonly found on the market) broke up to an extent such that all of the samples passed through a 5 mm mesh sieve at the end of the tests. Given that toilet paper is the only product that is known to be definitely flushable, its performance in the disintegration tests is taken as a reasonable benchmark for other products.

Stage 8

Question	Requirement
Can the disintegration products be easily removed from screens in CSOs and at treatment works by backwashing?	Screen Back-Wash test.

The material retained on the 5 mm sieve after the rinsing procedure in one test of either Stage 5 or 7, is rinsed again using the same procedure from the underside of the sieve. The mesh is visually inspected to determine whether all the material, which had not passed through, is removed, or are there still fibres entangled in the mesh of the sieve. If fibres are retained on the sieve then this indicates that there is likely to be a build up on the screens in CSOs and at treatment works.

This test, by its nature of being a visual, is not precise. The pass criterion has been set so that 75% of the fibres visually appear to have been removed by back rinsing. However this can only be a matter of judgement and there may be different opinions as to whether a particular sample has passed. The key judgement that needs to be made is whether the amount of material that is left on the sieve after back rinsing indicates that this product will lead to problems with cleaning the screens in treatment works and CSOs.

Stage 9

Question	Requirement
Are the product and its constituents biodegradable in the receiving environment?	Biodisintegration test or benchmarking against materials accepted as being biodegradable.

Assuming that the product has passed all the tests at previous stages, it is necessary to ensure that its disintegrated particles can be safely received by the environment. In particular the particles are likely to be removed as sludge from the treatment process and potentially the sludge cake could be applied to farmland as a natural fertiliser. Also the product could reach watercourses via CSOs. Hence it is important that any kind of flushable products have sufficiently disintegrated so as not to create any visible nuisance and that the broken down particles continue to degrade in the receiving soil.

It is proposed to test the resistance of disposable products to physical biodisintegration by using a Laboratory Soil Disintegration test. The development of such a test is outside the scope of this project and at the time of writing, the most appropriate test is in the WERF Protocol, Tier 2, page 5-3/4 and A-66/67/68.

The disintegration of a product is assessed when it is buried in soil combined with sludge biosolids. The product is required to biologically disintegrate in soil environments and be unrecognisable in a reasonable period of time. The product meets the requirements if more than 95% of the product mass passes through a 1 mm sieve after 56 days of exposure in a laboratory soil environment.

This test may not be required provided the product manufacturer provides acceptable test data that shows the product is biodegradable.

Given the focus on biodegradable materials in recent years, it is likely that other biodegradation and biodisintegration tests will be developed. If alternative test methods became available they may provide a suitable alternative to the currently proposed test.

2.3 Test report

The test report provides information on the results of the tests undertaken at each stage of the proposed WRc Protocol.

The detailed information on the results of individual tests and the reasons why any samples fail the tests are provided to assist the manufacturer in further product development that may be required.

3. PROPOSED TEST SPECIFICATIONS

3.1 WC Flush Clearance Test (Stage 3)

Equipment

A WRAS approved WC which provides a 6 litre flush.

The WC may be connected to the Drainline Rig used in Stage 4.

Procedure

Place the sample in the toilet bowl and flush it once using the full 6 litre flush. If the product does not clear the WC pan, wait for 5 minutes and flush again.

This test may be performed as part of the Drainline Test (Stage 4) described below.

Sample size:

- Toilet paper: 1 strip per test; each strip is folded to the size of one sheet of tissue; a strip should weigh between 3 and 4 grams.
- Wipes or other products: one product per test; wipes should be tested immediately after removal from their package so that they are still moist.
- If the manufacturer indicates a maximum number of products (generally flushable wipes) that can be disposed of in a single flush, then use this number of products in the test e.g. it is stated on the packaging for Kandoos that 5 can be flushed at a time.

Number of tests required

A minimum number of 10 tests shall be undertaken.

If the tests are being done in conjunction with the Drainline Tests (Stage 4) then the results of the first 10 tests shall be used for the WC Flush Clearance Test.

Pass/Fail Criteria

The sample must clear the WC bowl with a maximum of 2 flushes. The sample fails the test if either:

- It does not clear the bowl with 2 flushes; or,
- The WC bowl surcharges up to its rim at any time during the test.

It is proposed that this test requires a 100% pass rate.

3.2 Drainline Test (Stage 4)

Equipment

A test rig comprising a number of 1 m lengths of 100 mm diameter clear plastic pipe (PE or similar), joined using sleeved couplings with a 3-5 mm gap between two consecutive pipe lengths to form a straight drain line. A WC, as specified in Stage 3, shall be installed such that it discharges at the head of the resultant drain line. The distance from the point at which the WC discharges into the drain line to the end of the drain line shall be a minimum of 10 m.

The resultant Drainline Rig shall have a uniform gradient of 1:80.

A 300 mm long section of pipe with 55 g of 1-2 mm sharp grit uniformly glued to the bottom inner quarter of the pipe (45° symmetrical to the vertical diameter) shall be fitted to the Drainline Rig such that the upstream end of the grit is at least 8 m from where the toilet flush enters (i.e. 8 m downstream of the head of the line). This section shall have the facility to enable any products that snag on the grit to be removed.

Figure 3.1 shows the type and amount of grit to be used and the inner area of the pipe to which it should be bonded.

One possible approach is to cut the top off a pipe and refit the cut-off section using small hinges. This allows the top portion of the pipe to be opened to enable the grit to be glued to its invert and also facilitates the inspection and removal of any products that become snagged.

Procedure

The sample size shall be the same as required for Stage 3.

The testing procedure for each individual test shall be as follows:

1. Place specified quantity of product in the WC bowl.

2. Flush the WC once and wait for 5 minutes before flushing again.

3. Repeat this procedure until either;

    a. The sample clears the end of the Drainline, or

    b. Remains stationary for 2 further flushes.

4. If the sample remains stationary after one further flush but moves on the second flush, continue the test.

5. Record how many flushes are necessary for the sample to clear the Drainline or become stationary and the distance travelled on each flush.

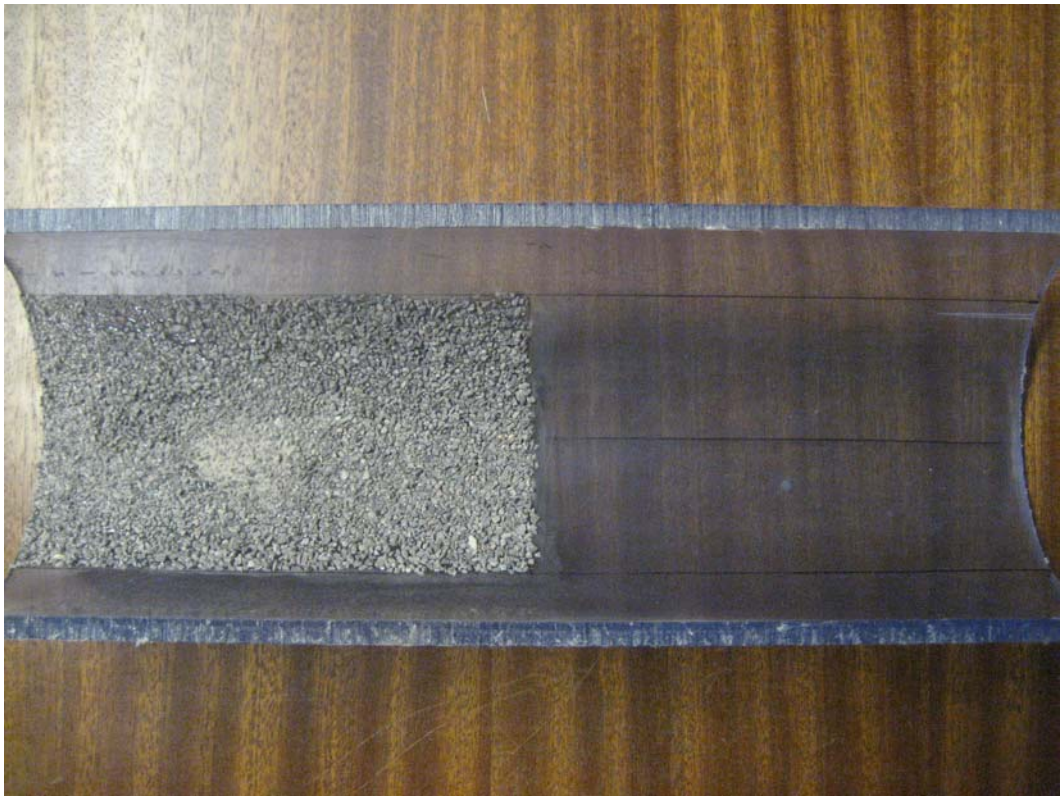

Figure 3.1 An example of 100 mm diameter pipe section with fine sharp grit glued to its inner bottom quarter surface

Number of tests required

100 samples of the product shall be tested.

Pass/Fail Criteria

For a sample to pass it must clear the Drainline Rig.

The product shall:

- Pass provided at least 98% of the samples pass.
- Fail if less than 90% of the samples pass.
- Be submitted for Household Drains Disintegration testing (Stage 5) if 90% but less than 98% of the samples, pass.

3.3 Household Drains Disintegration Test (Stage 5)

Equipment

A test rig comprising 75 mm bore clear flexible PVC tube (or similar) formed into a circular loop approximately 1m in diameter. A tee fitting shall be included to allow the loop to be partially filled with water and to enable the test samples to be introduced. A means of empting the pipe rig and removing the test sample shall be included.

The pipe loop shall be firmly attached to a laboratory orbital shaking table, which is capable of rocking the pipe loop at approximately 100 rpm.

One option is to include a length of clear rigid PVCu (or similar) pipe section approximately 300 mm long in the loop; one end of which is fitted to a union fitting to allow the loop to be separated for draining and cleaning purposes. This clear section also allows for further modifications to the test regime if desired, such as the introduction of obstacles or abrasive material. An example of such a rig is shown in Figure 3.2.

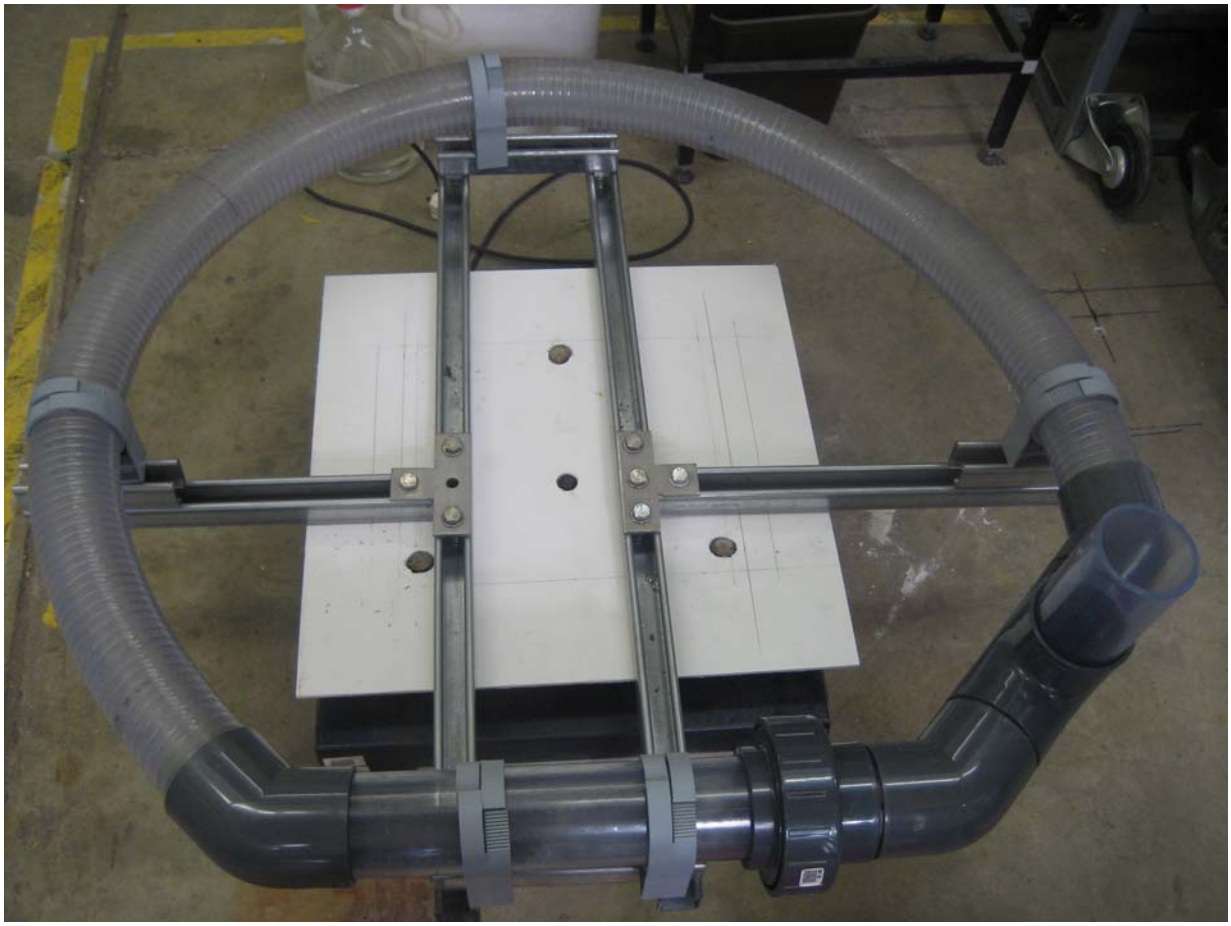

Figure 3.2. Example of a circular pipe flow rig

Sieve stack comprising a 10 mm and a 5 mm mesh sieves complying with ISO 3310-1[21].

Procedure

Sample size as in Stage 3.

The test procedure shall be as follows:

1. Dry three test samples in an oven at 105°C for 18 hours and leave in a desiccator until cool.

2. Weigh the three samples together using a laboratory balance and calculate the average dry weight of a sample.

3. Discard the dried samples.

4. Fill the pipe with 4 litres of mains tap water measured using a graduated 4 litre beaker and set the laboratory orbital shaking table to 100 rpm.

5. Introduce the sample via the tee fitting and agitate the pipe loop for up to 24 hours.

6. Drain the test media and the sample into a vessel, rinse any remaining sample fragments from the pipe loop into the vessel.

7. Pour the test media and the sample from the vessel through the sieve stack.

8. Rinse any fragments of product from the vessel onto the sieve stack.

9. Rinse the sieve stack using a hand-held shower head spray nozzle, gently rinse the sieve for 2 minutes at a flow rate of no more than 4 l/min (assessed by measuring the time it takes to fill a 4 litre beaker).

10. Remove the sample material retained on each sieve and place each size fraction on a previously weighed piece of filter paper. Label with the sample number and sieve size.

11. Dry the sample fractions from each sieve at 105°C for 18 hours.

12. Leave the sample fractions in a desiccator until cool.

13. Weigh each sample fraction using a laboratory balance. Record each weight and calculate the average weight and the % mass retained on each sieve.

14. Calculate the % mass that passed through the 5 mm sieve.

[21] ISO 3310 - 1:2000 Test Sieves - Technical Requirements and Testing - Part 1: Test Sieves of metal wire cloth

Number of tests required

Test each product three times.

Pass/Fail Criteria

100% of the mass of the sample must pass through the 10 mm mesh sieve and greater than 80% of the mass of the sample must pass through the 5.0 mm mesh sieve.

3.4 Pumping Station Disintegration Test (Stage 6)

Equipment

Three No. baffled conical flasks with 2 litre capacity.

Laboratory orbital shaking table capable of operating at 150 rpm.

Sieve stack comprising one 16 mm mesh sieve and one 10 mm mesh sieve complying with ISO 3310-1.

Procedure

Sample size as used in Stage 3.

The test procedure shall be as follows:

Dry and weigh 3 test samples and average their weights to determine the dry sample weight using the same procedure as used in the Stage 5 test.

Discard the dried samples.

Add approximately 1 litre of mains tap water measured using a graduated beaker to each flask.

Using the product directly from the packaging, add a test sample to each of the flasks.

Secure the flasks to the orbital shaker.

Set the orbital shaker to 150 rpm and run for a maximum of 6 hours.

Pour the test media and the sample from the flask through the sieve stack.

Rinse the sieve stack using the same procedure as used in Stage 5.

Dry, weigh and calculate the % masses retained on each sieve and the % pass-through using the same procedures as used in Stage 5.

Number of tests required

Test each product three times.

Pass/Fail Criteria

100% of the mass of the sample must pass through a 16 mm mesh sieve and greater than 80% of the mass of the sample must pass through a 10 mm mesh sieve.

3.5 Sewer System Disintegration Test (Stage 7)

Equipment

Three No. plain conical flasks (without baffles) with 2 litre capacity.

Laboratory orbital shaking table capable of operating at 100 rpm.

Sieve stack comprising one 10 mm mesh sieve and one 5 mm mesh sieve complying with ISO 3310-1.

Procedure

Follow the same procedure as used in the Stage 6 tests except that:

- Use plain conical flasks.
- Set the orbital shaker to 100 rpm and test for between 46 and 48 hours.
- Use 10 mm and 5 mm sieves.

Number of tests required

Test each product three times.

Pass/Fail Criteria

100% of the sample must pass through a 10 mm mesh sieve and greater than 80% of the sample must pass through a 5.0 mm mesh sieve.

3.6 Sieve Backwash Test (Stage 8)

Equipment

The 10 mm and 5 mm sieves used in either Stage 5 or Stage 7.

Procedure

After either Stage 5 or Stage 7 tests are completed, turn the stack of sieves (10 mm and 5 mm mesh size sieves) upside-down and repeat the rinsing procedure used in Stage 5.

Inspect the sieves for any fibres remaining on the sieve mesh.

Pass/Fail Criteria

The product fails if it appears visually that there are more than approximately 25% of the fibres left on the mesh of either sieve.

3.7 Biodisintegration Test (Stage 9)

The test is detailed in the WERF Protocol[22], Tier 2, pages 5-3 and A66/68. The following summarises the main points.

Equipment

Non-degradable 1.6 mm mesh bags.

Soil container; either a box or a plastic bin, with a layer of river pebbles for drainage overlaid by a mixture of top-soil and compost in a proportion of 3:1.

Procedure

Sample size as for Stage 3.

1. Dry and weigh samples as in Stage 3.
2. Place sample in the mesh bags and bury in soil.
3. Keep soil damp by adding tap water weekly.
4. Remove samples after 56 days.
5. Place contents of mesh bag in a 1mm mesh sieve and rinse using the same rinsing procedure as in Stage 5.
6. Collect remaining material from the sieve, dry, cool in a desiccator as in stage 3 and weigh.
7. Calculate the average % mass of the sample that passed through the sieve.

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[22] **Protocols to Assess the Breakdown of Flushable Consumer Products** *WERF Report: Treatment Processes/Systems (Project 02-CTS-7P),* C McAvoy, GA Rece, EL Schwab, BA Nuck, NR Itrich, RC Stark

Number of tests required

Test each product three times.

Pass/Fail Criteria

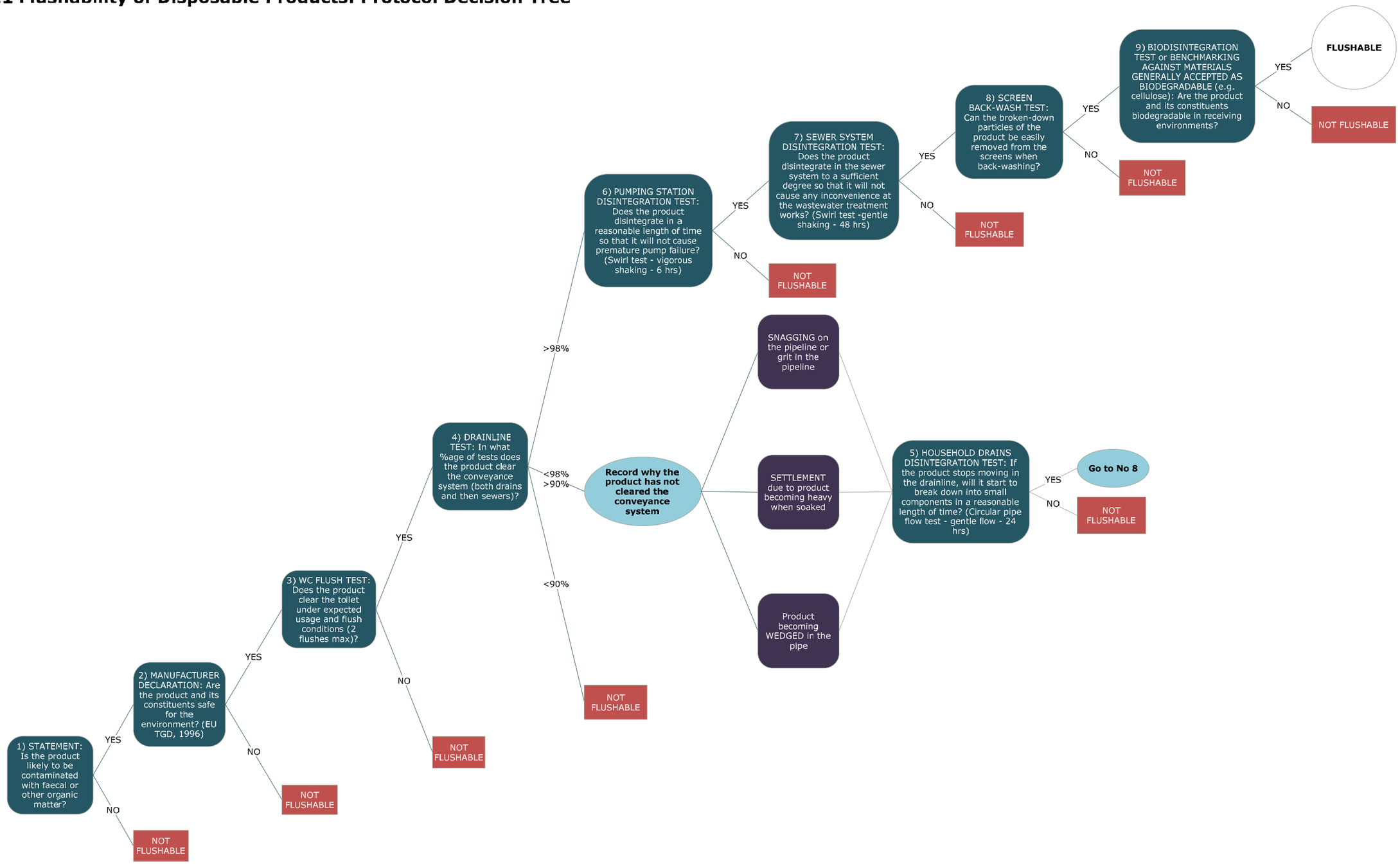
Pass criteria: more than 95% of the product mass must pass through the 1 mm sieve.

3.8 Test report

The test report shall include:

- A description of the product including any identifying marks, brand names etc.;
- A statement on whether the product is likely to be contaminated with faeces or other organic matter during use (Stage 1);
- The manufacturer's declaration on whether the product and its constituents are safe for the environment (Stage 2);
- The results from the Stage 3, Stage 4 and Stage 5 tests for each sample tested including;
    - The number of flushes necessary for the sample to clear the WC, Drainline or become stationary and the distance travelled on each flush,
    - The reason for failure for each sample tested;
- The results from Stage 6, Stage 7, Stage 8 and Stage 9 tests for each sample tested including reason for failure of each sample.

CP311 Flushability of Disposable Products: Protocol Decision Tree



4. CONCLUSIONS AND RECOMMENDATIONS

The proposed WRc Protocol provides the basis for a nationally agreed protocol to assess whether products are suitable for disposal via the sewerage system.

The tests require further refinement. The pass/fail criteria and the proposed WRc Protocol need to be agreed by the UK sewerage undertakers, manufacturers of disposable products and policy makers such as Defra and the Environment Agency.

It is known that the manufacturers of disposal products are developing their own test protocol via EDANA and INDA, the European and North American trade associations for non-woven paper products. Although it is unlikely that the requirements of the EDANA and INDA protocol will be exactly the same as the proposed WRc Protocol developed by the CP311 project there is a high degree of commonality in the approach taken by both protocols. It is understood that the EDANA and INDA protocol currently does not address the issue of snagging of products in the drain or sewer but that they are not opposed to considering including this when a suitable test becomes available. The EDANA and INDA protocol is currently confidential so no further details can be given in this report.