Department
for Environment
Food & Rural Affairs

A comparison of impacts on the sewer system caused by plastic and non-plastic wet wipes - main body

Report Reference: UC16380.03
February 2023

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Executive Summary

Wet wipes are widely available in the United Kingdom (UK) and are used for a broad range of applications, including within domestic, commercial, and healthcare settings for cleaning and personal care. They are often inappropriately disposed of into the sewer system via flushing contributing to significant impacts such as sewer blockages, pump clogs, fatbergs and the littering of the wider environment.

The UK Government has recently undertaken a call for evidence to explore future policy measures to tackle issues such as sewer blockages caused by wet wipes. One possible option includes a ban of the sale of wet wipes containing plastic. However, it should be noted that the inclusion of plastics is not the sole reason for wipes to cause problems in sewers; fibre density, fibre length and the method of fibre bonding (such as hydroentanglement, chemical bonding), can result in the production of wipes that do not disintegrate following disposal to the sewer.

The objectives of this research were to provide robust scientific evidence to assess the impacts of wet wipe components on blockage formation within simulated, small-diameter domestic drains and sewers. A selection of wipes was tested to determine disintegration, flushability and plastic content. The samples included wipes of differing composition (plastic and cellulose) as well as different types of wipes such as surface cleaning, toilet cleaning, facial cleaning, baby wipes, personal care moist toilet tissue and medical wipes.

Using the non-synthetic organic matter (Matière Organique Non-Synthétique (MONS)) test, initial testing identified the presence of plastic in several wipes. All of the wipes containing plastic materials failed drain line and sewer and disintegration tests, indicating they would largely remain intact in drains and sewers when flushed. Cellulose-based wet-wipes samples failed one or both disintegration tests, indicating they would not disintegrate sufficiently in the sewer, confirming that factors other than the use of plastics could prevent the breakup of these wipes. Of all the wet wipe samples investigated, only one product failed the toilet bowl clearance test.

Glossary

F2F	Fine to flush
FSC	Forest Stewardship Council
Microplastic	For the purpose of this project, microplastics are defined as in a size range between 0.1 to 5,000 µm or micrometres.
MTT	Moist Toilet Tissue
MONS	Matière organique non synthétique – non-synthetic organic matter
Plastics	For the purposes of this report plastic means a synthetic organic petro-chemical derived fibre material.
UK	The United Kingdom

1. Introduction

Wet wipes and other disposable products are some of the main causes of sewer blockages in sewers and at sewage pumping stations (Drinkwater & Moy, 2017). These blockages cost the water industry in England and Wales approximately £100 million a year (Orman, et al., 2020) to manage and address. Blockages can lead to sewer flooding and contributing to storm overflows (Orman & Drinkwater, 2018) and the associated negative environmental impacts and potential risk to human health when humans are exposed to raw sewage (WHO, 2017).

Sewer blockages have been associated specifically with plastic-containing wet wipes (Drinkwater & Moy, 2017), which has led to increased public pressure to remove plastics from wet wipes, and they are time consuming and expensive for water companies to remove (personal communication Thames Water, Welsh Water, United Utilities). Large masses of fats and oils typically incorporating wet wipes and other forms of wastewater debris (sanitary products, nappies, tissues, food waste, product packaging etc) are often colloquially referred to as 'fatbergs' (personal communication Thames Water). Fatbergs that build up in sewers may also include road grit, leaf litter, etc.

Wet wipes can contribute to freshwater and marine litter (Ó Briain, et al., 2020) and are a source of smaller and micro-sized plastic fibres/particles (Ball, et al., 2019) (McCoy, et al., 2020). Polyester fibres take a long time to break down in both water and on land, and as they do, they shed microplastics (Lee, et al., 2021). They pose a possible risk to wildlife when ingested by biota (McCoy, et al., 2020) and human health, but more evidence is needed to assess the level of risks at population levels (McCoy, et al., 2020). Other negative environmental impacts are associated with their production (Zhang, et al., 2021), (Chen, 2015). Wet wipes discharged into receiving waters from the sewer system during extreme storm responses via combined sewer overflows or other sewer flooding events, can be a source of faecal indicator organisms (Metcalf, et al., 2022), (McCoy, et al., 2020), (Ball, et al., 2019), (Woodward, et al., 2021). Faecal indicator organisms are used as the foremost technique for detecting and quantifying aquatic pollution due to sewage (Horam, 2003).

Wet wipes currently on sale in the UK consist of a substrate made either from plastic fibres (mainly polyesters), natural fibres (mainly natural cellulose, reconstituted cellulose materials (viscose or Lyocell or cotton) or a mixture of natural and plastic fibres. Materials can also be added which can temporarily or permanently modify the properties of natural fibres to provide wet strength. For temporary wet strength additives, the material is washed out when the product is immersed in water and the properties revert to the natural state (Campbell, 2015).

The more recently developed and manufactured wet wipe products using natural fibres are typically a blend of natural cellulose and viscose or Lyocell. At present, manufacturers are not required to specify the composition of the wipe substrate material on product packaging, and therefore it is difficult to confirm the composition for the individual products or assess the overall

use of plastics across all products on the market. However, to demonstrate environmental credentials to customers, a large proportion of retailers in the UK are moving away from wet wipes containing plastic to cellulose-based products and make implied or specific claims about the composition by displaying the Forest Stewardship Council (FSC) and/or Fine to Flush logos.

Viscose and Lyocell are derived from cellulose – a natural polymer found in all plants. Although viscose and Lyocell undergo processing to create a fibrous form, they are chemically identical to cellulose, and therefore when they break down, do not pose an environmental risk in the same way as microplastics (Choudhury, 2017). The processing of cellulose to produce viscose fibres requires the use of high concentrations of chemicals. Lyocell production does not require the use of chemicals and a significant proportion of the solvent used can be recovered for re-use (Choudhury, 2017).

It should be noted that the inclusion of plastics is not the sole reason for wipes to cause problems in sewers; fibre density, fibre length and the method of fibre bonding (such as hydroentanglement, chemical bonding), can result in the production of wipes that do not break up following disposal to the sewer (Beytullah, et al., 2022). Work at Water Research Centre Ltd (WRc) (Orman & Drinkwater, 2018) demonstrated that where a wipe disintegrates in a sewer, if it is caught on a feature in the sewer, the flow will cause the weakened wipe to tear, and the material will not accumulate. Where it does not disintegrate and the wipe is caught on a feature in the sewer, the whole wipe is retained and this presents a surface to which other wipes can adhere, leading to the build-up of a large mass of material.

This project has two principal objectives in the form of work packages (WPs):

- The primary objective is to consider the effect of wet wipes on the sewer system (WP1).
- The secondary objective is to consider the effects of plastic pollution in relation to wet wipes (WP2).

The work in this report covers work carried out as a part of WP1. This work will provide evidence for potential policy development in this area.

2. Methodology

2.1 Introduction

Water Research Centre Ltd (WRc) used the Fine-to-Flush (F2F) flushability tests (Water UK Standards Board, 2019) which are relevant to understand how a wipe performs in sewers and the tests were applied to a range of wet wipe product categories. The tests used were:

a) WC Bowl clearance;

b) Drain line clearance;

c) Disintegration in the drain line;

d) Disintegration in the sewer; and

e) Determination of Synthetic and Non-Synthetic Organic components.

The determination of synthetic and non-synthetic organic components test is a simplified test for plastics identification to indicate the presence of plastic components. In Work Package 2 more detailed testing was undertaken to identify the different types of fibres. This work will be described in a later report.

The disintegration tests replicate the hydraulic conditions in drains and sewers to demonstrate the dispersibility of wipes in the sewer network. The flushability and drain line clearance tests are a direct assessment of the ability of the wipe to pass through the building drainage without causing blockages. However, it should be noted that these tests are carried out assuming the disposal of single wipes. The formation of blockages is frequently the result of the multiple or frequent disposal of wipes combined with the resistance of the wipes to breakup allowing a slow accumulation of blockage material.

An additional test used in the F2F assessment is relevant to the primary treatment of sewage at wastewater treatment works and is not relevant to sewer blockages and so has not been used in this research.

2.2 Selection of wipes

Twelve wet wipe products were selected for testing based on branding and their availability in retail outlets and on-line sources. Samples of products were assigned a sample code A to L. Samples of plastic and non-plastic materials and different fibre lengths from a range of product types were selected. The selection was based on previous research carried out by WRc for

Water UK as part of their 21st Century Drainage (Drinkwater & Moy, 2017) programme which identified the types of wipes commonly found in sewer blockages. These included:

- baby/toddler wipes;
- make-up removal wipes;
- general cleaning wipes;
- personal care moist toilet tissue (MTT); and
- medical wipes.

An initial assessment was made of the substrate material by tearing a wipe and examining the length and strength of the individual fibres as the two sides of the tear were pulled apart. Products are summarised below in Table 2.1. The material compositions of wipes were later verified during the testing and are reported in Table 3.1.

Table 2.1. Product selection.

Product	Product Type	Initial assessment of Material	Whether labelled as flushable	Domestic or Commercial
A	Surface Wipe	Plastic	No	Domestic
B	Toilet Cleaning Wipe	Cellulose	Certified	Domestic
C	Facial Cleaning Wipe	Plastic	No	Domestic
D	Facial Cleaning Wipe	Cellulose	No	Domestic
E	Baby Wipe	Plastic	No	Domestic
F	Baby Wipe	Cellulose	Certified	Domestic
G	Moist Toilet Tissue	Cellulose	Certified	Domestic
H	Moist Toilet Tissue	Plastic	No	Domestic
I	Medical Wipe	Cellulose	Certified	Domestic
J	Medical Wipe	Plastic	No	Commercial
K	Surface Wipe	Plastic	No	Commercial
L	Baby Wipe	Plastic	No	Domestic

2.3 Laboratory tests

A series of laboratory and rig tests were carried out to provide a direct comparison between plastic and non-plastic containing substrates and differing fibre lengths on the potential for blockage formation.

2.3.1 Sewer and drain line disintegration tests

The purpose of these tests was to assess the comparative disintegration of the various types of wipes in the different categories and to determine if there is a correlation between fibre length and the breakup of the wipes to give a potential indication of the influence of fibre length on a blockage occurring. The two tests replicate the hydraulic conditions in small diameter drains and in larger sewers by calculating the relative Reynolds number (a dimensionless value for hydraulic conditions considering pipe diameter, average flow velocity, the density and dynamic viscosity of the flowing fluid) for the pipes and the test equipment. The results enable the identification of the types of wipes most likely to cause issues in sewer network.

Photograph 2.1. Orbital shaker table

Source: WRc'

Each sample was placed in a flask of water on an orbital shaker table (see Photograph 2.1) and for drain line and sewer disintegration testing the samples were rotated for 3 and 6 hours, respectively. Samples were then removed, photographed, sieved through perforated plate sieves (2.5 mm perforated plate sieve (round holes) for Drain disintegration, 5.6 mm perforated plate sieve (round holes) for sewer disintegration with the residual material dried in an oven at

105°C alongside control (non-processed samples) and quality control (samples of a known disintegration) samples. The percentage remaining in the sieve was then calculated and the percentage material lost from the sample determined. The material lost is referenced against threshold values specified in the current Water Industry Specification (WIS 4-02-06) used as the F2F criteria for satisfactory product disintegration.

The requirement/pass criteria for drain line and sewer disintegration tests are specified in in Appendixes C and E of WIS 4-02-06 (Water UK Standards Board, 2019) and are the following:

Drain line disintegration

When tested in accordance with the method specified in Appendix C of WIS 4-02-06 Issue 1.2 (Water UK Standards Board, 2019), on 5 occasions, the product passes this test if it disintegrates sufficiently so that at least 50% of the product mass (average of five replicates) shall pass through the 12.5 mm perforated sieve.

If the product does not pass the test, but at least 40% of the product mass for each of the replicates pass through the 12.5mm perforated plate sieve, then the *Snagging in the Drain line* test will be carried out. (For the purposes of this study, this clause is not employed).

Negative values are calculated against an average 'control' value. The weight of the material lost is within the range of control values used to calculate the average and therefore represent a zero-material loss.

Sewer disintegration

When tested in accordance with the method specified in Appendix E of WIS 4-02-06 Issue 1.2 (Water UK Standards Board, 2019), on five occasions, the product passes this test if:

1) Greater than 80% of the product mass (average of five individual samples) passes through the 5.6 mm perforated plate sieve: and
2) For the product mass that does not pass through the 5.6 mm sieve, a good and relatively uniform break up pattern (where no individual piece is greater than 40 mm in the largest dimension) is apparent.

Alternatively:

3) Where photographic evidence of break up to 25 mm or less has been obtained and clumping of the sample is noted at the sieving stage, the pass rate will be reduced to 60% of the product mass passing through the 5.6 mm perforated plate sieve for each of the replicates.

If the product does not pass criteria 1) and 2), and the alternative criterion 3) does not apply, then the Snagging in the Drain line test will be carried out. (For the purposes of this study, this clause is not employed).

Negative values are calculated against an average ‘control’ value. The weight of the material lost is within the range of control values used to calculate the average and therefore represent a zero-material loss.

2.3.2 Determination of Synthetic and Non-Synthetic Organic components

The Determination of Synthetic and Non-Synthetic Organic components test also called the MONS test (Matière Organique Non Synthétique) derives from a French Standard NF U44-164:2014 (AFNOR, 2014). The purpose of the MONS test was to confirm which products contain synthetic organic material (e.g., Petro-chemical-hydrocarbon derived plastic fibres) and to quantify the proportion of plastic fibres used in each product. The test dissolves natural organic material (cellulose) in a test sample leaving synthetic organic material (plastics) as a test residue. Any remaining synthetic organic matter were dried (at 105°C) and weighed to calculate the percentage weight. The requirements of MONS tests are included in Appendix G of WIS 4-02-06 Issue 1.2 (Water UK Standards Board, 2019). Each sample shall pass through the 0.5 mm sieve without leaving fibres or other visible residue(s).

2.3.3 WC toilet clearance

The purpose of WC toilet clearance test is to confirm that the sample will pass through the WC water trap (U-bend), and not cause the WC to surcharge up to its rim or overflow. When tested in accordance with the method specified in Appendix A of WIS 4-02-06 Issue 1.2 (Water UK Standards Board, 2019), on 40 occasions, the product shall pass if:

1) Greater than 95% of the products tested clear the bowl in no more than two flushes: and

2) Any surcharging of the bowl is below the rim on 100% of the tests.

2.3.4 Drain line clearance test

Drain line clearance testing was carried out to assess the risk of the product settling out or snagging as it passes through the drain/sewer close to a property which could lead to a blockage. This testing was completed utilising the WRc drain line clearance rig (see

Photograph 2.2 with a toilet discharging to a 20 m length of drain line. to represent an actual domestic drain scenario. Samples were flushed with a standard 4.5 L flushing volume and the distance reached with each flush was recorded until the wipe travels the full 20 m length of drain.

Photograph 2.2. WRc Drain line Clearance Test Rig

Source: WRc

The combined results enable identification of the type of products that cause issues in small diameter drains and sewers close to a property where a significant proportion of blockages occur. (Blanksby, et al., 2002) . The purpose of the test is to assess the risk of the product settling out or snagging as it passes through the drain line. When tested in accordance with the method specified in Appendix B of WIS 4-02-06 Issue 1.2, in at least 95% of the 40 tests, the product shall:

1) Travel a distance of at least 20 m along the drain line within five consecutive flushes; and

2) Not remain stationary for more than three consecutive flushes.

The combined results enable identification of the type of products that cause issues in small diameter drains and sewers close to a property where a significant proportion of blockages occur (Blanksby, et al., 2002).

3. Results

The results of the laboratory tests described in Section 2 are summarised in Table 3.1.

Four of the twelve samples were found to contain plastics (Samples C, J, K and L). Of these, one was a facial cleaning wipe (Sample C), one was a medical wipe (Sample J), one was a surface cleaning wipe (Sample K) and the other was a baby wipe (Sample L).

Only four of the samples (B, F, G & I) tested passed all the tests and these were those that had previously been certified to WIS 4-02-06 and the packaging was marked with the Fine-to-Flush mark.

The initial erroneous assessment that samples A (a surface cleaning wipe), E (a baby wipe) and H (a moist toilet tissue) had a synthetic petro-chemical plastic substrate may indicate that the cellulose fibres had similar properties to synthetic petro-chemical plastic fibres.

All wet wipe products, with the exception of a surface cleaning wipe (K), passed the WC bowl and the drain line clearance tests.

When considering the drain line and sewer disintegration tests which examine the properties of the wipes that may impact on the sewer system in terms of leading to possible drain and/or sewer blockages, all of the plastic-based products (samples C, J, K and L) failed including some of the cellulose-based products (samples A, D, E and H).

Samples A, E and H have not passed the disintegration tests. These three samples account for three of the four non-plastic samples that failed the disintegration tests.

Samples J and K are sold as commercial wipes.

The coefficient of variation (standard deviation divided by mean) of the results for the 5 individual samples tested for each product, for both the drain line and sewer disintegration was high for Sample G (drain line – CoV =137% and sewer CoV = 80.4%), however, this sample still met the pass criteria of the disintegration in drain and sewer tests.

Other samples were moderately repeatable (with Sample B meeting the pass criteria, while samples A, C, D, E,H, J, K, L did not meet the test pass criteria). Sample F (CoV = 77% and CoV = 27.6%) and Sample I (CoV = 25.5% and CoV = 42%) were less repeatable, but overall met the test pass criteria.

Table 3.1. Summary of results for the testing as outlined in Section 2.3.

Ref	Product Type	Material	WC clearance test	Drain line clearance test	Disintegration in drain line				Disintegration in sewer system				MONS Test
					Average (n = 5) mass retained [g]	One standard deviation (g)	Co-efficient of variation (%)	(% passing)	Average (n=5) mass retained [g]	Standard deviation (g)	Co-efficient of variation (%)	(% passing)	
A	**Surface Wipe**	Cellulose	Pass (100%)	Pass (100%)	1.1210	0.0766	6.8	**Fail** (7%)	1.1489	0.0484	4.2%	**Fail (3.17%)**	No residue (Pass)
B	Toilet Cleaning Wipe	Cellulose	Pass (100%)	Pass (100%)	0.8075	0.1910	23.7	Pass (56.68%)	0.4507	0.1097	24.4	Pass (75.45%)	No residue (Pass)
C	**Facial Cleaning Wipe**	Plastic	Pass (97.5%)	Pass (100%)	1.7141	0.0362	2.1	**Fail** (0.98%)	1.7239	0.0291	1.7	**Fail (-14%)**	90.6% residue (Fail)
D	**Facial Cleaning Wipe**	Cellulose	Pass (100%)	Pass (100%)	1.5944	0.0134	0.8	**Fail (3.19%)**	1.6185	0.0723	4.5	**Fail (-1.5%)**	No residue (Pass)
E	**Baby Wipe**	Cellulose	Pass (100%)	Pass (100%)	1.423	0.1297	9.1	**Fail (13.9%)**	1.4083	0.0442	3.1	**Fail (17.25%)**	No residue (Pass)
F	Baby Wipe	Cellulose	Pass (100%)	Pass (100%)	0.1004	0.0774	77.1 (%)	Pass (89.64%)	0.1354	0.0373	27.6	Pass (88.65%)	Pass
G	Moist Toilet Tissue	Cellulose	Pass (100%)	Pass (100%)	0.0239	0.0328	137 %	Pass (98.01%)	0.0294	0.0236	80.4	Pass (97.65%)	No residue (Pass)

Ref	Product Type	Material	WC clearance test	Drain line clearance test	Disintegration in drain line				Disintegration in sewer system				MONS Test
					Average (n = 5) mass retained [g]	One standard deviation (g)	Co-efficient of variation (%)	(% passing)	Average (n=5) mass retained [g]	Standard deviation (g)	Co-efficient of variation (%)	(% passing)	
H [(1)]	**Moist Toilet Tissue**	Cellulose	Pass (100%)	Pass (100%)	1.4681	0.0412	2.8	**Fail (0.2%)**	1.4695	0.0406	2.8	**Fail (-0.9%)**	No residue (Pass)
I	Medical Wipe	Cellulose	Pass (100%)	Pass (100%)	0.5541	0.1412	25.5	Pass (71.51%)	0.3721	0.1564	42	Pass (81.06%)	No residue (Pass)
J	**Medical Wipe**[(2)]	Plastic	Pass (100%)	Pass (97.50%)	1.1377	0.0592	5.2	**Fail (-3.96%)**	1.0633	0.0158	1.5	**Fail (4.96%**	90.1% residue (Fail)
K	**Surface Wipe**[(2)]	Plastic	**Fail (95%)**	Pass (97.5%)	1.2771	0.0657	5.1	**Fail (3.69%)**	1.2524	0.0244	2	**Fail (4,58%)**	72.0% residue (Fai)
L	**Baby Wipe**	Plastic	Pass (100%)	Pass (100%)	1.2523	0.0371	3	**Fail (5.54%)**	1.2724	0.0509	4	**Fail (2.7%)**	82.3% residue (Fail)

4. Discussion

4.1 Test results

The scope of the Fine-to-Flush WIS 4-02-06 is limited to products that when used are “likely to become contaminated with faecal or other bodily waste that could contain water-borne diseases”. On this basis, not all the wipes tested in this study fall within the scope of the Fine-to-Flush scheme. Facial cleaning wipes, surface wipes and some medical wipes do not fall within the scope of the scheme and should not be flushed. All the wipes tested in this study carrying the Fine to Flush Certification Mark (samples B,F,G, and I) passed all the flushability tests .

WRc could not obtain a Moist Toilet Tissue currently on the market that contained plastics. An initial assessment of sample H made by tearing a wipe and examining the length and strength of the individual fibres as the two sides of the tear were pulled apart suggested was that it was made of a substrate material containing plastic. The selected sample “behaved” as a plastic sample when products were initially screened.

All wet wipe products, with the exception of a surface cleaning wipe (K), passed the WC bowl and the drain line clearance tests, indicating that if they were to be deposited in the WC, they would be unlikely to block the internal plumbing system of the property. While disposal of a surface cleaning wipe such as sample K to the drainage system might not be the normal, if it is used in a bathroom or WC, as some were during the COVID-19 pandemic, disposal to the drainage system cannot be ruled out.

When considering the results of the drain line and sewer disintegration tests which examine the disintegration properties of the wipes that may impact on the sewer system in terms of leading to drain and/or sewer blockages, all of the plastic-based products (samples C, J, K and L) and also some of the cellulose-based products (samples A, D, E and H) failed these disintegration tests. This indicates that these products may cause drain and/or sewer blockages if flushed. There are three possible explanations for this:

a) The substrate had been treated with a material that modified the properties of the cellulose to give it permanent wet strength (Campbell, 2015);

b) The length of the fibres and the extent of entanglement of the fibres during manufacture creating a material that disintegrates more slowly; and/or

c) That all or some of the cellulose had been reconstituted (e.g., as lyocell or viscose) creating a material that disintegrates more slowly.

4.2 Effect on sewer systems

The small diameter sewers serving relatively few properties, in which the majority of blockages occur, only have intermittent foul flows. The movement of large solids in intermittent flow is largely by a sliding motion (Littlewood & Butler, 2003). When a wipe which readily disintegrates in water passes over a small area of high friction, whether a sharp point or a sediment bed, it is retained only for a short period until the forces caused by the passing flow tear the wipe at the relatively few points of contact and it is released (Orman & Drinkwater, 2018). If the wipe does not disintegrate, it remains in place and will provide a surface which for additional wipes and other objects in the sewer flow can adhere because contact is across an area and not only at a few points. Once a wipe has passed through the smaller sewers, it may still cause a blockage at a pumping station as it can foul on sharp edges of a damaged pump impeller which are sometimes the result of grit or larger stones in the sewer. Furthermore, depending on what size the wipe has disintegrated to, large amounts of such material can blind the screens at wastewater treatment works and combined sewer overflows.

While none of the plastics-based wipes passed the drain line and sewer disintegration tests in this study, some of the cellulose-based wipes also failed the tests. Therefore, removal of all plastics from wipes will not prevent the issue of sewer blockages caused by wet wipes altogether. The reasons for the failure of those cellulose wipes that did not pass the disintegration tests should be investigated. In particular, the effect of proportions of reconstituted cellulose fibres such as viscose and Lyocell included should be investigated as well as fibre length and entanglement.

With large composite blockages such as fatbergs, these are expensive to deal with, removal of the wipes is only one part of this problem and the quantity of fat discharged may still cause a blockage. The larger number of small blockages that are caused by wipes alone may have a higher overall cost. The balance between these two costs can only be determined with better data on the number of each type of blockage and the relative costs. It should also be noted that there were blockages in sewers before wipes were brought onto the market. A study carried out in 1954 reported that immediate causes of blockages in drains and sewers are sanitary towels, newspapers, rags, grease, and “others” (Institution of Public Health Engineers, 1954).

4.3 Microfibres and plastics

The results from the MONS tests for those products that failed (samples C, J, K, and L) indicate that between 72% and 91% of the plastic-based wipes were made from petro-chemical derived plastic. Further work would be required to estimate the amount of wipes that disintegrate and the microplastics they produce e.g. in proportion to fibres released from washing.

5. Conclusions

The following conclusions can be made:

1) A selection of wipes was tested to determine the plastic content, their flushability and disintegration properties. The samples included wipes of differing composition (plastic and cellulose) as well as different types of wipes such as surface wipe, toilet cleaning, facial cleaning, baby wipe, moist toilet tissue and medical wipes.

2) It was established that four (samples C, J, K, and L) of the 12 samples contained plastic material. These were facial cleaning, medical, surface cleaning and baby wipes. These failed the disintegration tests and would remain largely intact if flushed. The commercial medical wipe also failed the WC bowl clearance test but the other three might reasonably be discharged into the sewers system following use.

3) Four 4 of the eight samples that did not contain plastics failed the disintegration tests, indicating they may not disintegrate in the sewer. Of these, three were initially assessed as containing plastic.

4) WRc couldn't obtain a Moist Toilet Tissue, currently on the market, that contained plastics. This is an improvement of the situation three years ago when the majority of wipes either contained plastics, or if cellulose based, were manufactured in such a way as to produce wipes that did not readily disperse.

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