Flushability and Biodegradability – Two Sides of the Same Coin

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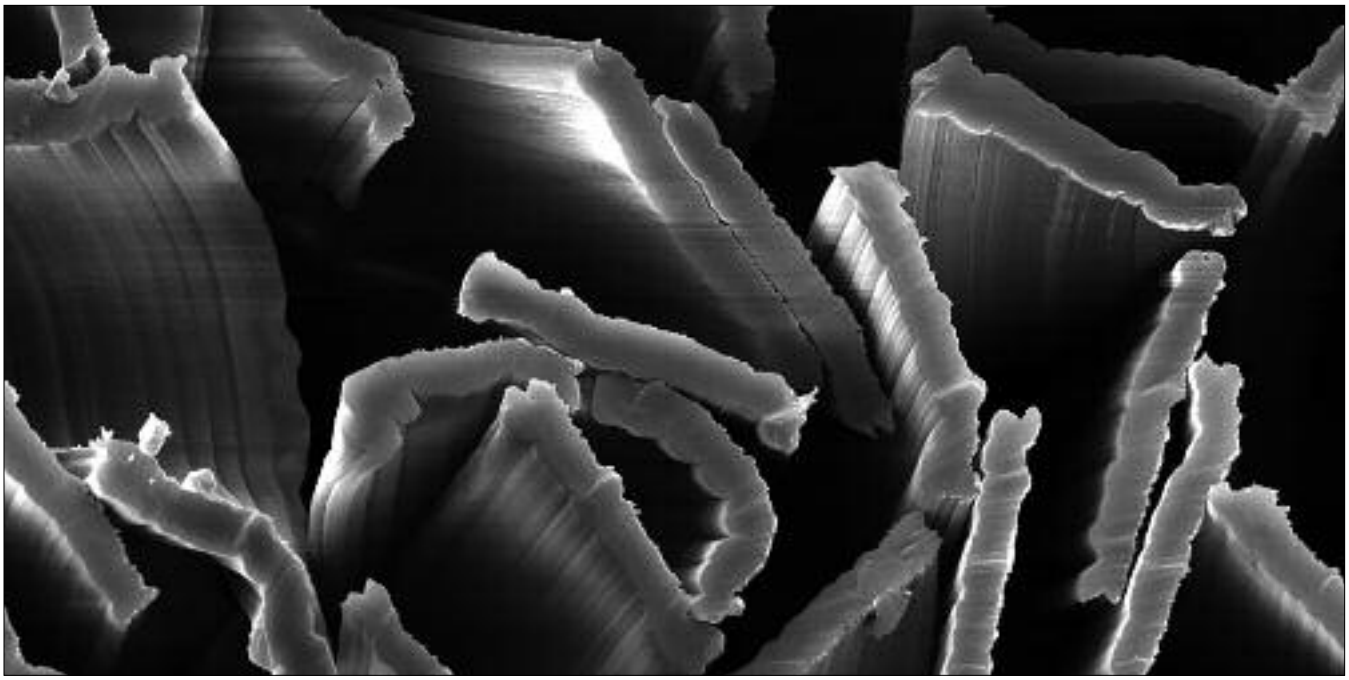

Figure 1: Viloft short cut fibers have high stiffness on the narrow side and low stiffness on the long side.

A joint project between viscose fiber manufacturer Kelheim Fibres, Abwasserzweckverband (AKV) Saal (wastewater authority) and pump manufacturer WILO took the three partners down into the sewers. The focus was on wet wipes, which can cause enormous problems in sewage systems worldwide.

The reason for this is the rapidly growing popularity of these convenient products as well as the often incorrect disposal of wipes via the toilet.

The latter is often a result of unclear classification of different wipes: the packaging often lacks a description of the wipe's material as well as plain information regarding their correct disposal.

The project was designed to test whether Viloft short cut fibers, which are produced by Kelheim Fibres specifically for biodegradable wet wipes, dissolve in water and can prevent the problem of blocked pumps.

These specialty fibers are characterized by their flat cross-section and their short fiber length – both have proven particularly beneficial for a fast disintegration of wet wipes.

The short fibers prevent entanglement of the filaments while the different stiffness of the sides offers a high impulse transmission, which enables easy separation and therefore a fast disintegration of the nonwoven (Figure 1)..

The situation in sewage plants has changed as the market penetration of wet wipe products has increased. Johann Schicklgruber, managing director of AZV Saal, explained that there is a pump truck on standby 24/7 to set acutely blocked pumps in motion again. These blockages are mostly caused by non-dispersible wet wipes that are incorrectly disposed of through the sewage system and agglomerate and build larger blockages.

This leads to increasing costs through the use of pump trucks, as well as by higher maintenance costs and shorter machine life, or through additionally installed shredders, or the growing amount of solids, which the sewage plants need to dispose of subsequently.

On the manufacturer's side, there are also efforts to adapt to the challenging situation. The European and American nonwovens associations EDANA and INDA have been dealing with the "flushability" topic for more than 10 years: a corresponding guideline currently exists in its third version.

Figure 2: Analysis of a real blockage found in one of the pumps of AZV Saal: the cause is undispersed wet wipes (e.g. baby wipes). All samples contained polyester and long viscose fibers and were manufactured in typical spunlace processes (for high strength).

This describes in detail tests that reflect the different aspects of the sewage system and define the requirements for flushable wipes. The two most important criteria are: the disintegration of the wipe in the sewer and the biodegradability of the material.

The project partners focused on the bottleneck of the wastewater treatment system. Horst Wörner, project manager at Kelheim Fibres, said: "We concentrated on the pumps. And then we went a step further and verified the lab results in a real pump station. After all, it has to work in practice." (Figure2).

LABORATORY TEST

For the laboratory test at WILO, Hof, a container was built to simulate a real-life situation in a pump station.

Reference products to the wipes made of Viloft (30% Viloft short cut viscose fiber, 70% pulp) were standard wet wipes from a well-known retail brand (15% viscose long fiber, 85% polyester fiber) as well as regular dry toilet paper (100% pulp, 5-ply folded). During the test, the electric current consumption and vibration of the pump were all electronically monitored.

The test showed a significant increase in current consumption and vibration, culminating in a total blockage of the pump when the conventional wipes were added. This was in contrast to the smooth operation of the pump for Viloft wipes with regular toilet paper.

SEWER SYSTEM TEST

The next tests were conducted to prove the transferability of these results to everyday practice. They took place in the local sewage system of AZV Saal/Kelheim, upstream of the pump station in Gronsdorf.

The wipes were added to a free-

Figure 3: The use of a pump truck was necessary to ensure further operation of the pump.

Overview

(300 wipes in 10 minutes)

	A	s [A]
Spunlace	18,43	0,60
Viloft	12,22	0,06
Toilet paper	12,17	0,05

Comparison of current consumption of the pump when confronted with different wipes

flowing canal system upstream of the pump chamber (the pumps were the same as in the laboratory test at WILO). Electric current, voltage and vibration of the pumps were monitored online. The overload cut-off of the pumps was raised to 20 A. The condition of the wipes in the inlet of the pumping station was monitored via video.

fter an average retention time of 12 minutes, the conventional wipes arrived intact at the pump sump. They showed no sign of disintegration and tended to agglomerate.

From stage three (50 wipes in 10 minutes) there was a significant rise in the pump load. From stage five (170 wipes in 10 minutes) shutdown of the pump could only be prevented by raising the overload limits.

A significant proportion of wipes could not be transported through the pumps and thus led to blockages in both pumps. To continue operations, it was necessary to request a pump truck for cleaning the pump chamber.

The flushable Viloft wipes also arrived intact at the pump sump.

But even with 300 wipes in 10 minutes, there was no measurable increase in the pump load. The pump worked smoothly and there was no recognizable vibration. Projected for one day, this would amount to a load of 40,000 wipes.

Even the toilet paper had not completely disintegrated when arriving at the pump sump. Nevertheless, there was no recognizable increase in the pump load, not even with 300 x 5 sheets in 10 minutes. The power consumption remained constantly at a low level, the pump operated smoothly and without recognizable vibration.

TEST CONCLUSION

The field test clearly validates the results from the previous test at the WILO laboratory. In none of the tests did regular wet wipes available commercially fulfill the requirements of EDANA/INDA for flushable wipes. Instead, they resulted in a significant increase of the load or even to an overload of the pumps, which in turn means higher maintenance costs as well as a shorter machine life and therefore higher costs.

However, the use of flushable Viloft wipes prevents the problem from the outset. Projections have shown that with the use of Viloft wipes the maintenance costs of pump stations could be reduced by more than 50%. Currently, this would mean savings of almost €200 million for the German wastewater authorities – and the charges for wastewater could be reduced by 4%.

At the same time, the use of Viloft wipes could reduce the energy consumption for wastewater transport by 4%. This corresponds to a saving of almost 100 GWh per year or the output of 20 wind turbines.

Peter Grabinger, plant manager at the wastewater treatment plant in Saal, commented: "Viloft technology offers a comprehensive solution for the current clogging problems in our pumps. It is now important to make Viloft wipes commercially available in the market."

Beside the commercial availability of these wipes – the Viloft wipes used in the test came from one of Kelheim Fibres' American customers – a clear labelling of wet wipes and consumer education are other important steps for the increasing proliferation of appropriate flushable wipes and therefore for future cost-effective wastewater management with affordable charges.

Local wastewater management, however, has its limitations. In severe weather conditions, for example when the incoming water exceeds the capac-

ity of the sewer systems, so-called "overflow-systems" apply.

Here, the incoming water bypasses the sewers without being treated in the wastewater treatment plant. It enters rivers and finally oceans, which brings another aspect into public awareness: marine litter.

BEYOND THE SEWER

Looking beyond the boundaries of local wastewater management, there is a second, equally important aspect regarding the disposal of wet wipes.

Globally, about 1.1 million tons of nonwovens are used for wipes applications every year, around 60% of this amount is based on petrochemicals.

A large percentage of these wipes is used for baby and personal care and these wipes are more likely to be disposed of incorrectly, either via the toilet, or even directly discharged.

In 2014, for example, the Marine Conservation Society cleaned and surveyed more than 300 beaches in the UK. It stated that most of the litter found starts in the bathroom – and wet wipes are one of the worst offenders. In 2014, the number of wet wipes found on UK beaches increased by more than 50% compared with 2013.

So even when wipes pass through the sewer system without blockages, wipes based on petrochemicals will always leave traces in the water: parts of these wipes or even only small fibers will enter rivers.

They become a significant part of the vast amount of plastic waste – estimates range from 4.4 to 13 million tons - that pollute the oceans every year.

Not only is the quantity of marine litter enormous, but so is the time it takes to disintegrate – up to 450 years.

During this time, plastic waste poses a threat for marine life. It can cause numerous injuries or, when swallowed, can lead to a blocking of ingestion and therefore to a cruel death for the animal. Small synthetic particles enter our food chain as "microplastics" – with consequences yet unknown.

Since the recycling of personal hygiene products is a challenging task, the best choice is to substitute the non-degradable by biodegradable components wherever possible, particularly in such disposable applications.

Viloft fibers and wipes made of Viloft and cellulose are completely biodegradable. Viloft, as with all viscose fibers, is made of cellulose – the most abundant material in nature and a renewable raw material of which all plants are made. Therefore, the biodegradation of cellulose is a naturally occurring process in nature.

After intensive testing, Viloft has earned the marine biodegradable certification from the Belgian certification body Vinçotte as well as the "compostable" sign, both confirming Viloft's high biodegradability in different environments.

In conclusion, it is not sufficient for flushable wipes to pass through the toilet and local sewer system without causing blockages. All wipes that are disposed of via the toilet need to be completely biodegradable as they invariably enter our environment and particularly our oceans. Flushability and biodegradability are just two sides of the same coin.

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