Analysis of fat, oil, and grease deposits in sagging sanitary sewers

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EXTENDED ABSTRACT

Despite regular, proactive sewer cleaning, blockages occur frequently in the sanitary sewers of Amsterdam (0,65 blockages/km/year, table 1). A survey among sewer personnel revealed that fat, oil and grease (FOG) deposits are believed to be the mayor cause of blockages in sanitary sewers. This observation is consistent with reports from the United States were FOG deposits cause 50-70% of the sanitary sewer overflows (Keener *et al.* 2008). As low flow velocities are known to enhance the formation of FOG deposits (Water Research Centre, 2009) and sags in sewers are abundantly present in the Amsterdam sewer system due to unequal settlement (Dirksen *et al*., 2011), a project was initiated to analyze FOG deposits in sagging sewers.

Table 1: frequency of blockage for different types of systems in the city of Amsterdam

Type of sub-system	# of sub-systems	km sanitary sewer	km combined sewer	# reactive cleaning activities (2006-2010)	blockages /year/km
Combined sewer system	31	12	481	1062	0,45
Separate sewer system – sanitary sewer	264	784	<1	2518	0,65
Combination of both types	16	45	37	199	0,5

For this study in total 100 sanitary sewers were selected. All selected sewers discharge wastewater from residential areas and are made from PVC with a diameter of 340mm. Since sewers with different ages (1980-2009) and different settlement characteristics (3mm/year – 7mm/year) were selected the subset contained sewers with sags ranging from a few centimetres up to more than a pipe diameter. Additional information about proactive and reactive cleaning, historical settlement and inspection results were also gathered. In order to assess the amount of deposits and the filling rate of the sewer pipe, the selected sewers are, if possible, inspected before and after hydraulic jet cleaning. During the inspection of the cleaned sewer pipe the vertical profile of the sewer was measured using the integrated tilt measurement of the IBAK KRA85 camera tractor.

Figure 1 shows the results for a sewer with a filling rate of 100%. As can be seen the amount of FOG deposits increases with increasing water level. At low water levels (<50% filling rate) FOG deposits accumulate slightly above the low-flow water mark (photograph at 3,9m). At a distance of 7m deposits are formed on the soffit of the pipe indicating that the water level was higher for some period of time, most likely caused by a partial blockage down stream. At the moment of inspection the pipe was not yet fully blocked as can be seen at the outflow of the sewer. This picture also shows that no deposits are formed in the

downstream part of the sewer. This phenomenon was observed at more locations indicating FOG deposits to tend to accumulate at one location.

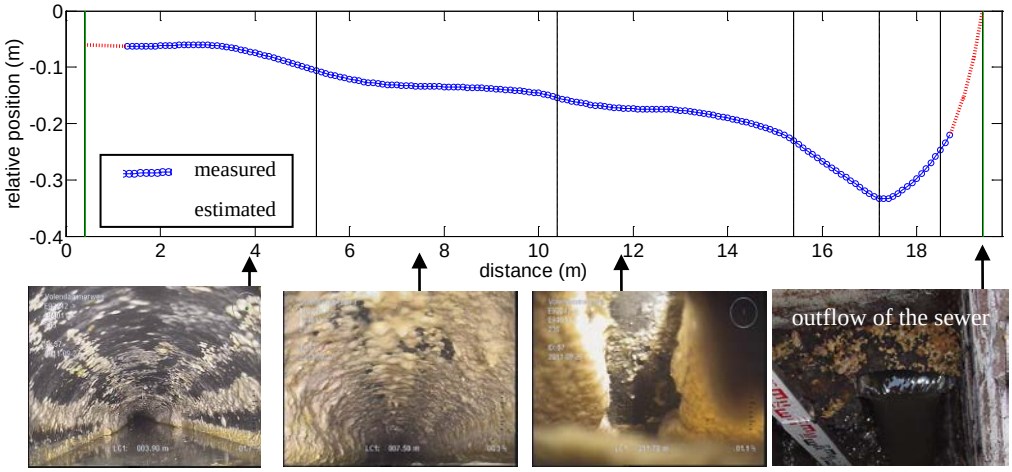

Figure 1: Inspection result of a sewer with a filling rate of 100%. The graph represents the vertical cross section of the sewer.

In addition, historical information about proactive and reactive cleaning was gathered (table 2). From this data and the observations shown in figure 1 (pipe almost blocked) it has been concluded that thorough hydraulic jet cleaning can help to prevent blockages in this specific sewer when done at least once every year.

Table 2. Record of proactive and reactive cleaning.

Date	Event	Action
Feb. 2005	proactive cleaning	hydraulic jet cleaning of whole system
Dec. 2007	complain: blocked sewer	hydraulic jet cleaning until water level drops
March 2008	complain: sewerage is exiting system via manhole	hydraulic jet cleaning until water level drops
Nov. 2009	proactive cleaning	hydraulic jet cleaning of whole system
Nov. 2010	sewer inspection	hydraulic jet cleaning of whole system
Oct. 2011	inspection for research	hydraulic jet cleaning of single sewer

The analysis of the selected 100 sanitary sewers, relating blockage frequency and FOG deposit build-up in sagging sewers will ultimately help the sewer manager to find effective measures to prevent blockages in sagging sewers by either increasing proactive cleaning frequencies or replacing sewers before high filling rates occur due to unequal settlement.

References

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