State of the Sewer System in Germany*)

Results of the DWA survey 2015

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Since 1984/85 the German Association for Water Management, Wastewater and Waste (DWA) has regularly carried out surveys on the state of the sewerage in Germany. This survey is currently the seventh of the series. The objective is to collect the most representative possible picture of the state of the sewerage in Germany. 339 sewerage system operators from all parts of Germany took part in the survey. They represent 22.56 million inhabitants, corresponding to 27.9 % of the total population of Germany.

Current data from the Federal Statistical Office is available on the length, year of construction and type of the public sewerage. The total length of the sewerage in Germany grew from 561,581 km in 2010 to 575,580 km in 2013. This corresponds to a growth of 2.5 %. In total, the length of the sewerage has grown by 176,359 km since 1995 – this is about 10,000 kilometres per year (Figure 1).

Of this increase, 29,372 km represents an extension of the combined network, 96,862 km represents an extension to the sanitary sewage network, and 50,144 km is an extension of the stormwater network. The reasons for the growth are to be found primarily in the increasing further development of existing combined and separate systems, along with the conversion of existing combined systems into separate systems. In addition to this, the construction of high-level traffic routes, together with an expanded knowledge of sewers that already exist and that have been found in the course of the continuing registration of the state of the sewerage and added to the inventory databases, represent subsidiary reasons for this rise.

The median of the public sewerage system length of the cities and municipalities who took part in this survey was 8.34 m per inhabitant, and is thus somewhat lower than the mean value of 9.31 m per inhabitant.

Age of the sewerage

Taking the lengths associated with the respective age classes into account, a figure of 39.8 years results for the average network age for the participant's sewerage. In communities with a population of less than 10,000 P, more than 45 % of the network is less than 25 years old, the mean age being 25.5 years. The average age of the sewerage rises with increasing size of the cities and municipalities. Finally, in large cities with more than 250,000 inhabitants, more than 40 % of the sewerage system is more than 50 years old. The average age of the sewerage system here is 50 years. It is not, however, possible to draw conclusions about the condition of the network or the need for rehabilitation on the basis of age alone since, for example, brickwork sewers with an age of more than 100 years are often still in very good condition.

Material distribution in the sewerage

The proportion of stonework and concrete rises with increasing size of the cities and municipalities. Precisely the opposite is true for plastic pipes. Whereas the proportion of plastic in the sewage systems of communities with less than 10,000 inhabitants is 18.4%, it is only 5.5% in large cities with more than 250,000 inhabitants. It is possible that on the one hand there is a relationship between the age structure and the distribution of materials, since in smaller communities the sewerage system is often newer, and the use of plastics has only increased in recent decades. On the other hand, sewers with a small diameter, which are increasingly found in small local authorities, are often made of plastic. The high proportion of other, or even unknown, materials in municipalities with less than 10,000 inhabitants is also noticeable. This proportion also falls as the size of the community grows. An extrapolation from the material distribution indicates that the largest proportion of the sewerages, with a figure of 38.4 %, is made of concrete. The

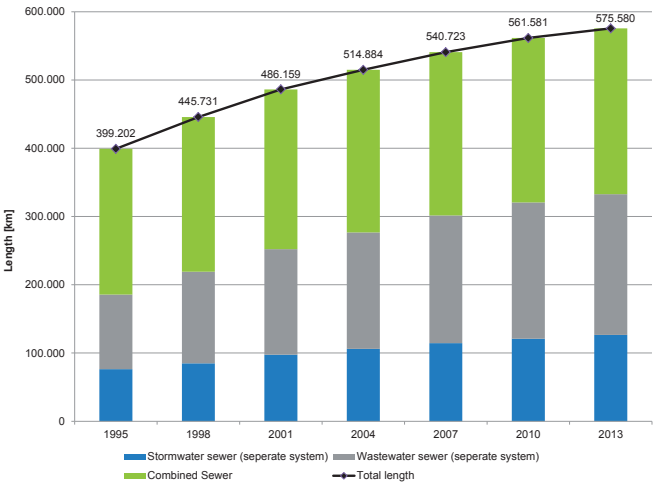

Fig. 1: Change in the length of the sewerage system in Germany (1995–2013)

*) The full evaluation of the survey was published in German in *KA Korrespondenz Abwasser, Abfall* 2016, *63* (6), and can be downloaded from the internet at: *http://de.dwa.de/umfrage-zum-zustand-der-kanalisation-in-deutschland-5209.html*

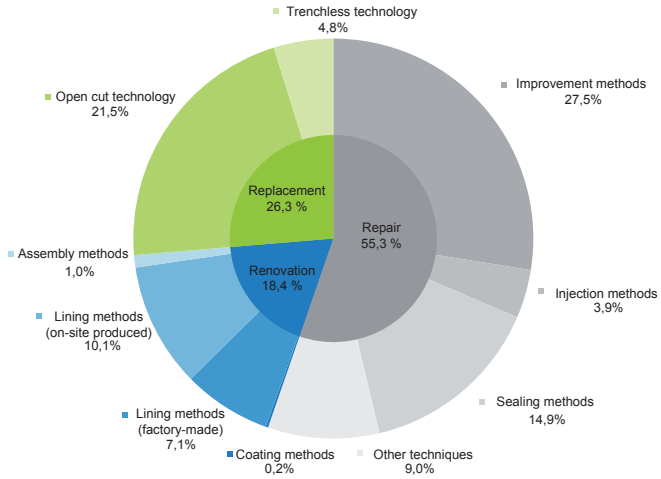

Fig. 2: Distribution of rehabilitation methods (n = 194; Σ = 85,289 km)

proportion of stonework comes next, at 31.0 %. 16.3 % of the sewerage system in Germany is made of plastic.

Description of the condition of the sewerage

The distribution of damage in the wastewater drains and sewers was questioned in the survey. 218 sewerage system operators provided answers. The most frequent types of damage were those of "protruding or faulty connection" (21 %) followed by "crack formation" (19 %). Sorted according to frequency, the damage classes of "connection (displaced or protruding gasket)" (13 %), "flow obstacles (roots, deposits)" (11 %) and "surface damage (including corrosion and abrasion)"(10 %) followed. The average faulty length per reach reported by the survey participants was 5.42 m; the average number of defects in each reach was 3.5.

Description of the condition of manholes

The degree of recording and knowledge of the structural condition of manhole structures is significantly lower than the knowledge over reaches. The evaluation of the distribution of defects at manholes (n = 208; Σ = 1,809,861 shafts represented) leads to the result that damage to the covers and frames of the manholes (26 %) continues to be the most frequent cause of damage. This is followed in frequency by damage to the climbing aids (22 %) and the connections (12 %) to the manholes. The faults of "infiltration/exfiltration/protruding sealant material)" and "formation of cracks" are each assigned 9 % of the total damage to manholes.

Need for rehabilitation

The results of the survey indicate that the proportion of reaches in condition classes 0 to 2, and which thereby have a need for rehabilitation in the short-to-medium term, was 23.8 % amongst those sewage network operators who took part in the survey. If this proportion is transferred to the data from the Federal Statistical Office on the distribution of local authority sizes over the whole of Germany, a proportion of 19.4 % results.

Rehabilitation methods

In the most recent collection of data, the relining method, at 93.5 %, remained the most frequently used method of renovation. The current distribution of rehabilitation methods used in Germany by participants in the survey in 2013 can be seen in Figure 2. Over the data collection period of the current survey, a total proportion of 5.5 % of the sewerage system was renovated, corresponding to an annually renovated proportion of 1.1 %, or 6,331 km of sewerage system.

It is clear that the proportion of rehabilitation done by replacement continues to fall. The proportion of the renovation method, at just under 20 %, remains almost the same. The high proportion of repair methods, which, at 55.3 %, make up the major part of the rehabilitation methods, is noticeable. At 49.8 %, the mending method is the most frequently used repair method.

Investment in sewer rehabilitation

As in previous surveys, the investment in rehabilitation was questioned. The results of the previous and current surveys are collected in Table 1.

It can clearly be seen that the costs per metre of sewer rehabilitation are low for the methods grouped under "repair", and have fallen considerably for those methods grouped under "renovation". The costs for renewals on the other hand have hardly changed. Possible causes for the marked reduction in the price per metre for renovation methods include further development of the renovation technologies, associated with an increase in the efficiency as well as, in some cases, a change in

		Rehabilitation costs [€]	Length [km]	Costs [€ per m]	Kilometres of network represented	Number of communities
Repair	2004–2008*)	71 202 284	549	130	31 994	36
	2009–2013	208 547 641	1 852	113	53 453	106
Renovation	2004–2008*)	312 798 892	404	773	40 019	37
	2009–2013	302 507 583	734	411	56 231	97
Replacement	2004–2008*)	1 188 111 147	778	1526	43 540	42
	2009–2013	1 311 741 035	828	1584	60 585	104

*) Condition of the sewage system – results of the DWA survey 2009, *KA* 1/2011, 24–39

Table 1: Rehabilitation costs

the nominal diameters of the renovated sewers. Related data was, however, not requested in the survey.

Length of the private drainage system

The length of the private sewerage system is often estimated to be several times the length of the public sewerage system. The overall length of the house-drainage systems was asked for in this survey in order to update these estimates. On the basis of the responses from 27 sewerage system operators who provided information on the length of the house-drainage systems, both a median and a mean value for the ratio to the length of the respective public sewerage system of about 2 is found. Extrapolating from this, the current total length of the house-drainage systems in Germany can be calculated to be around 1.1 million kilometres.

Conclusions

The survey shows that very extensive knowledge of the condition of the public sewerage is available in Germany, and that sewer management in terms of value retention and maintenance of operational capability is comprehensively implemented. Nevertheless, about one fifth of all sewer reaches have damage that must be rehabilitated in the short-to-medium term. The results of this survey thus also indicate a high need for investment for the sustained management of the "invisible" infrastructure of residential settlement drainage. It is necessary that rehabilitation strategies that either exist or require preparation are implemented in order to counter long-term erosion of the assets of the public sewerage system. This requires those municipal decision makers to be provided with information and to be alerted to the issue.

The average age of the sewerage in Germany is below 40 years. Concrete and stonework are the most frequently used materials. The proportion of plastic pipes continues to rise. The proportion of rehabilitation methods involving renewal continues to fall; the proportion of repairs is increasing, the proportion of renovation methods is unchanged. A total of 1.1 % of the sewerage system in Germany is rehabilitated annually.

The level of knowledge regarding the condition of house-drainage systems is still low. Extrapolation gives an overall length of about 1.1 million kilometres for house-drainage systems in Germany. Most citizens are able to obtain advice relating to the registration of the condition and the rehabilitation of their house-drainage system through the operator of the public sewerage.

Acknowledgement

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