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Setting the course for future generations

A plea for technical and economic far-sightedness in the construction and operation of public sewage installations.

Dr.-Ing. Andreas J. Kuck, Aachen, Germany

Introduction

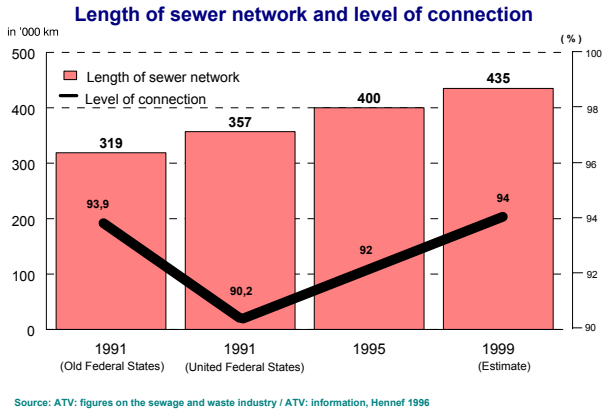
Current statistics show that every citizen in Germany pays DEM 224 per annum in charges and contributions for sewage disposal.

Even without taking into account the costs of fresh water supply, this results in payments of almost DEM 1,000 per annum for a 4-person household. In addition to the construction and operation of sewage works, the majority of this money is spent to guarantee safe, reliable drainage of sewage through pipes and sewers. The approximately 400,000 km of public sewers in Germany are long-term capital assets with a replacement value which can be assumed to be at least DEM 300 billion. Therefore, the planning, construction and operation of sewage installations must take place today in such a way that reliable disposal is guaranteed for future generations as well.

Taking stock

Currently an average of approximately 5 m of public sewer per citizen is available for the disposal of rainwater and waste water. To this are added multiples of this length of pipe on private property. At the start of the 90s, just under 94% of properties were connected to the sewer network in the states of the former West Germany; the value was approximately 90% (fig. 1) as an average for all the states of Germany.

If the aim of raising the level of connections to 94% overall again by the end of the decade is to be achieved, the local authorities and sewage associations are faced with a great challenge in the next few years.



Source: ATV: figures on the sewage and waste industry / ATV: information, Hennef 1996

Fig. 1: As a result of increased measures, the sewer connection level of the states of the former West Germany can be reached again in Germany by the millennium.

In its fundamental principles, public sewage disposal is conceived as a cost-effective national task. In particular, the trend of the last few years to replace the previously widespread organisational form of a state-owned enterprise by owner-operated enterprises is contributing to consistently converting this principle. The arrangement of sewage disposal according to business management principles with clear earmarking of the funds used thereby receives lasting support.

In recent years, the financial burden on citizens as a result of sewage disposal has been the object of many matter-of-fact and often also extremely emotional discussions. A direct comparison of just the volume-related sewage charges (DEM/m^3) in various disposal areas is not very meaningful today as the local authorities and associations also use the instrument of contribution payments to varying degrees. Furthermore, the various charges have also become even more confused as a result of the split scales of charges in some regions for precipitation water (DEM/m^3) and waste water (DEM/m^3).

In particular in the states of the former East Germany, it was noticed in past years that, as a result of the high proportion of fixed costs for disposal, the sewage charge (DEM/m^3) depends to a great degree on the actual supply of fresh water

Annual remuneration

Federal State	Population (E)		Remuneration	
	actual (x 1.000)	surveyed (%)	fees (DEM / (E*a))	subscription + fees (DEM / (E*a))
Baden - Wurtemberg	10.224	25	146	170
Bavaria	11.863	37	199	230
Berlin	3.475	100	295	296
Brandenburg	2.538	9	206	211
Bremen	683	80	233	233
Hamburg	1.703	100	238	238
Hessia	5.957	32	217	224
Mecklenburg - Hither Pomerania	1.843	4	227	242
Lower Saxony	7.641	35	193	228
North-Rhine Westphalia	17.759	39	216	232
Rhineland Palatinate	3.962	43	165	214
Saar District	1.075	36	305	314
Saxony	4.608	34	134	135
Saxony - Anhalt	2.778	33	153	155
Schleswig - Holstein	2.696	36	249	257
Thuringia	2.533	26	137	138
Total	**81.338**	**38**	**207**	**224**
East	17.775	39	219	220
West	63.563	37	204	226

Source: ATV: Remuneration enquiry 1996, Hennef

Fig. 2: The per capita burden on the citizens shows considerable differences between the states of Germany. In the states of the former East Germany, the figures will increase further in the future as a result of increased contributions.

as a calculation variable. If fresh water use decreases, the volume-related sewage charge can therefore rise if the overall costs of sewage disposal remain constant. Therefore, in this context, the charge survey made by the German Waste Water Engineering Organisation (Abwassertechnische Vereinigung – ATV) in 1996 is meaningful and informative. The survey established for the first time the total annual burden of charges on citizens (DEM/(E*a)) in the individual states of Germany (fig. 2).

The figures show great regional differences: thus the Federal State of Saarland is the most expensive at 314 DEM/(E*a), more than 130 % more than the lowest burden of charges in Saxony with 135 DEM/(E*a). A comparison between the states of the former West Germany and East Germany shows that the annual burdens per capita of 220 and 226 DEM/(E*a) are very close. Furthermore, the low significance of contribution payments in the states of the former East Germany can be seen, while the states of the former West Germany finance 10% of their revenue from contributions. The reason for this is that the preconditions (for example, drainage and sewage regulations, completion of installations, capacity of the administration) are often still lacking in the East German states. However, a harmonisation of conditions can be expected in the near future.

The sewage charges are determined to a great degree by the financing costs of the structures. Operating costs and personnel costs and the sewage tax contribute 26%, 16% and 3% to the charges. According to a survey of disposal enterprises, however, expenses for interest and depreciation on the installation account, at 55% on average in Germany, for more than half of the charges made (fig.3).

It seems reasonable to search for approaches for optimisation/reduction in particular for the estimated costs because percentage changes here have the greatest effect on the absolute size of the costs. The possibilities for influencing interest payments, at least on outside capital, are limited. However, in many cases, depreciation offers starting points for long-term optimisation of costs and thus of charges.

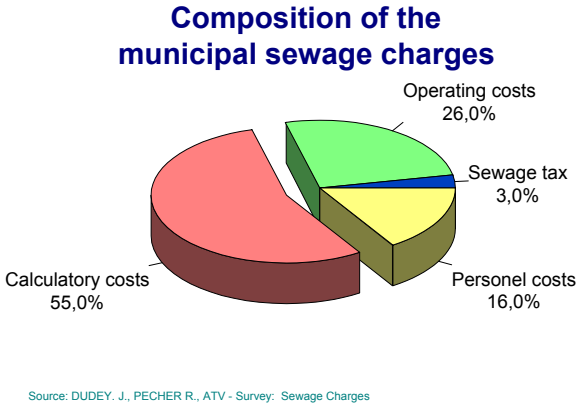


Fig. 3 The estimated costs for depreciation and interest are significant determining factors for the sewage charges. Low rates of depreciation with longer service life represent the main possibility for influencing these costs.

Correct valuation of the existing sewers

The amount of depreciation is determined by two factors: investment sum and depreciation period. These two variables are not always clearly linked, but it can often be established that higher investments lead to increases in quality which result in an extension of the life of the structure. Higher investment sums are thus acceptable if a clear qualitative improvement in the structure is achieved thereby. The Joint Committee on Water (Länderarbeitsgemeinschaft Wasser – LAWA) has published guideline values on the life of various sewers (fig. 4). Furthermore, tables with corresponding values are also known from the Federal Ministry of Construction (Bundesbauministerium) (value-determination guidelines) and the Federal Ministry of Transport (Bundesministerium für Verkehr) (redemption guidelines).

LAWA 1992		
Sewers	**50 - 60**	**years**
(excluding those made of vitrified clay and plastics)		
Sewers made of vitrified clay	**80 - 100**	**years**
Sewers made of plastics	**50**	**years**
LAWA 1963		
Sewers	**50 - 80 (100)**	**years**

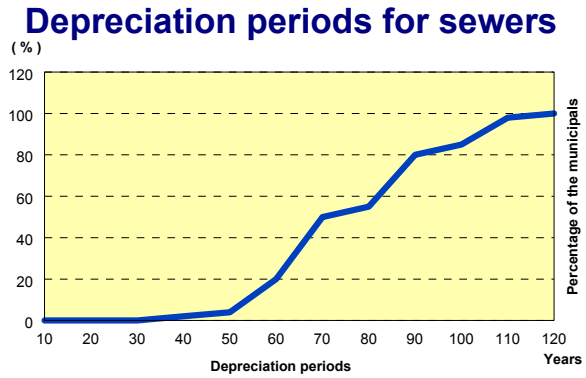
Guidelines for the undertaking of cost comparing calculations

Fig. 4: Many years of operating experience lead to a differentiated determination of the life of sewers in many local authorities and sewage associations.

The LAWA data on the life of sewers are confirmed in practice by the fact that most local authorities and sewage associations set similar periods when determining depreciation. A survey completed in the spring of 1996, in which all German towns and cities with more than 50,000 inhabitants were surveyed (189 local authorities, 93% response), produced the following result: by far the majority of the local authorities differentiates when determining rates of depreciation. The differentiation is made according to the pipe materials used. On the basis of the many years of experience of the operators with individual materials, very long periods are set in some cases. For example, vitrified clay sewers (42% of the sewers in the public sewer network) are assessed by a great number of local authorities and associations to have a depreciation period of 80 years and more, in some cases even over 100 years (fig. 5).

These long depreciation periods seem at first sight to be set very high. In fact, there has been repeated discussion recently in specialist circles about whether the actual life of sewers in the public sewage disposal network is not actually shorter

and that, consequently, the depreciation period/rate should be adjusted in the operators' calculations.



Survey: Municipal Waste Water Disposal, STEINZEUG GmbH, April 1996

Fig. 5: Most German local authorities use different depreciation periods for the various pipe materials when calculating sewage charges.

For, and here there is general agreement, in connection with a proper determination of sewage charges, it is necessary precisely for the depreciation cost factor to ensure that the depreciation period fixed and the actual life agree. If the structures are depreciated over longer periods than those for which they are used, the costs are transferred to future generations. On the other hand, if the depreciation period is too short, the citizens today will be burdened with too high charges and contributions for sewage disposal. In view of the already high burden of charges in some regions, this is anything but desirable.

A current evaluation of video material, which was recorded in a sewer television study of approx. 1,000 km of public sewers in more than 30 German local authorities, is also extremely informative in this connection. In addition to the inspection results of the manhole lengths inspected (condition class 1 to 6: „in need of renewal" to „as new"), the processing engineers also had information on the pipe materials used and the age of the structures at their disposal.

The result of the evaluation of more than 23,000manhole lengths was represented as the „ service life“; the highest values were produced for sewers of vitrified clay, which are in use in the networks of the local authorities investigated for an average of 112
years (fig. 6).

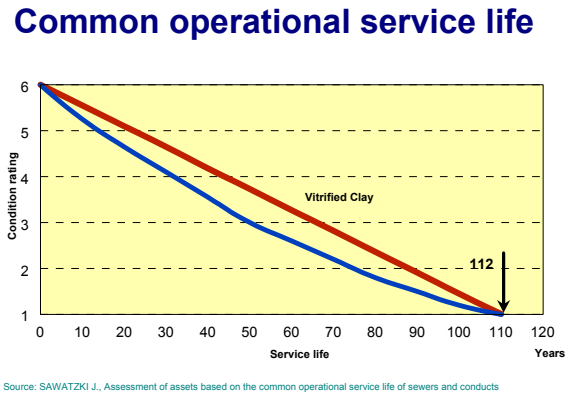


Fig. 6: Studies on the existing drainage and sewerage network confirm that a significant part of the sewers achieve a long life in practice.

Against the background of the LAWA recommendation and the results of the survey on depreciation practice in the large German local authorities, it can, therefore, be established that some of the structures in the sewer network achieve much longer lives than previously assumed. Logically, the depreciation period for such long-lived sewers can also be extended. This is necessary already for reasons of fairness in respect of charges. Such an approach results in a low rate of depreciation in the calculation of the operator and leads directly to lower annual financing costs and thus finally to lower sewage charges.

A precondition for the realisation of such a strategy is clear allocation of construction and maintenance costs and of inspection data to the individual sewer manhole length. For most operators, this has
so far been undertaken by means of appropriate sewer files. In view of the increasingly prevalent sewer information systems in database or property information system (GIS) form, many local authorities and associations are able to realise this today with even fewer problems in technical terms.

Mature, adapted planning of new structures

In addition to correct technical and financial evaluation of existing sewage installations, investment costs form the second important influence factor on sewage charges. In this connection, concepts have increasingly been presented recently which are intended to cause a drastic reduction in investment sums in connection with new construction measures. From the point of view of responsible installation operators, the realisation of such proposals will always have to be preceded by careful examination which goes beyond the temporary investment requirement and includes aspects of operating safety, maintenance and operating expenditure and the expected life.

It says something for far-sighted planning when many local authorities and sewage associations do not succumb to the temptation only to have temporary cost reduction as their aim. The experience of a great number of operators shows that even in times of high investment requirements and simultaneously scarce public funds, relinquishment of solid planning principles and high-quality construction can have fatal consequences; already in the medium term, serious negative effects on the technical resources of the disposal network can be ascertained with this approach. Furthermore, it can be observed that in many cases increased operating costs or replacement investments required at an early stage more than eat up the one-off savings effect in connection with the construction of the structure.

However, it should not be underestimated that there are also responsible concepts in this area, in connection with which the investment costs are

reduced and from which long-term financial advantages for both the citizen and the operator develop. An analysis of the components of sewer construction costs makes clear that the main components are to be found in the area of costs for

for tearing up and making good roads, on the one hand, and in excavation work and sheeting, on the other hand. There is actually considerable potential for savings here if, for instance, in rural areas the sewers can be laid outside fortified areas or the level of the pipes and sewers is reduced to the technically absolutely necessary amount.

Similarly constructive proposals can be found, for instance, in the ATV code of practice „Principles for sewage disposal in rural areas“, which is expected to appear in mid-1997 as a work sheet (A 200) and thus to acquire the status of a generally accepted technical rule. In addition to many tips on optimising technical planning and construction, the document emphasises the particular significance of cost comparison calculation as an important instrument for the study of variants in the planning and decision phase of a project.

Study of the economic efficiency of new construction measures

Cost comparison calculations based on the LAWA guidelines have established themselves as the prevalent instrument for studying economic efficiency. Using these objective, comprehensible evaluations, technical construction and operation variants of an installation can be compared from the points of view of economics and business administration. There are essentially two different methods of representation: 1) the project cost cash value which determines the accumulated total costs of a project at a selected time or 2) the annual costs which express the average annual financing expenditure (depreciation, interest) during the depreciation period of an installation.

The principle for both forms of representation is that, in addition to the investment costs of a structure, all consequential costs (operation, maintenance, etc.) are included for the entire expected life or depreciation period.

From the point of view of their information value, both representations are completely equal; however, for reasons of better clearness, the comparison of annual costs is often preferred. Using a real, practical example, it will be shown in the following how the instrument of cost comparison calculation is used to decide between two construction variants: two quotations for the construction of a connection collector are considered. The quotation sums differ by 8.5% (variant A: DEM 1,999,100, variant B: DEM 1,843,300). The main technical difference between the quotations concerns the different pipe materials proposed for the construction. On the basis of previous operating experience of the municipal client and according to the technical estimation of the engineering company commissioned to carry out the planning, the average life and depreciation period for the pipe material proposed for variant B is 50 years. For variant A, a life of at least 80 years is assumed for the higher-quality pipe material, in accordance with the recommendations of LAWA. Within the framework of this example, the same annual operating and maintenance expenditure is estimated for both variants. The tabular comparison of annual costs (fig. 7) shows an average annual financing cost of DEM 71,641 for depreciation and interest for the investment costs for variant B, which are depreciated over 50 years. Already at this time, it is necessary, from the point of view of the client, to reckon with necessary replacement investments (renovation, renewal) for variant B.

Development of the annual costs

Investment costs	**Variant A :**	**1999100 DEM**
	Variant B :	**1843300 DEM**

Depreciation period (Years)	Annual costs (DEM)	
	Variant A	**Variant B**
46	80.690	74.400
47	79.886	73.659
48	79.121	72.954
49	78.392	72.282
50	77.697	***71.641***
51	77.034	
52	76.401	
53	75.797	
54	75.219	
55	74.666	
56	74.137	
57	73.630	
58	73.145	
59	72.680	
60	72.235	
61	71.807	
62	***71.397***	
63	71.003	
64	70.625	
65	70.261	
66	69.912	
67	69.576	
68	69.253	
69	68.942	
70	68.643	
71	68.356	

Calculation to the *LAWA - Guidelines for cost comparing calculations* using a real interest of 3 %

Fig. 7: Despite additional costs for the construction of a high-quality sewer, in the end lower annual costs are produced for depreciation and interest from the longer life and depreciation period.

Variant A, which is more expensive to construct, demonstrates annual costs which are approximately DEM 6,000 higher if it is depreciated over the same period. If the actual possible life and depreciation period are, however, longer, as expected, the annual costs are clearly reduced with every additional year. Already with depreciation over 62 years, the average annual financing cost for variant A during the entire depreciation period is less than the above annual costs of variant B.

The financial advantage of the more expensive but higher-quality construction (variant A) thus appears clearly and is achieved already before the expected minimum life of the pipe material of 80 years.

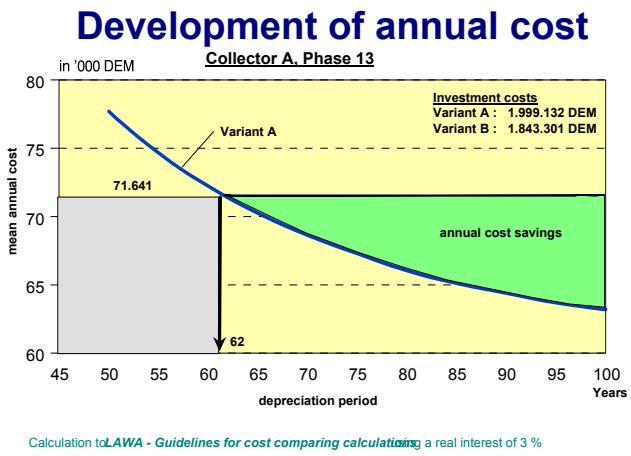


Fig.9: As the depreciation period increases, the high-quality, long-lived sewer demonstrates its financial advantage ever more clearly.

This relation can be illustrated in a graph (fig. 8): the area marked in blue corresponds to the saved annual costs if the high-quality construction variant A with a longer life is chosen. For the operator, this situation offers additional security as well as immediate financial benefit in which the citizens also participate in the form of lower sewage charges.

In this connection, for the sake of completeness it is necessary to emphasise that, of course, in addition to the selection of high-quality pipe materials and suitable construction methods, the care taken in the execution of the construction also has a direct effect on the quality of the sewer structure. An expert opinion presented by „Sewer construction quality protection“ (Güteschutz Kanalbau), Bad Honnef, in 1996 points out that the frequency of damage or defects in carefully supervised sewer construction sites is up to 75% less than in construction sites which are not supervised. According to the experts, it is possible to increase the life of the drainage and sewerage installations overall by means of quality supervision. The resulting savings potential for „avoided investments“ is estimated at DEM 1.8 billion per annum.

Outlook

Safe and technically reliable sewage disposal must not be called into question in the future either. This requires long-term economical solutions which are payable by the citizens, in particular with regard to sewerage. The aim is only achievable with a clear commitment to high quality and thus to long-lived structures which result in low imputations. Precisely in times when finances are tight, the principle of solid planning and careful, high-quality construction for drainage and sewerage installations must therefore be given particular attention. At the moment, „cheap“ solutions result only in a transfer of the financing problem and burden future generations already today. The expert opinion on sewer construction quality protection quoted above concludes: „The population has a particular right to expect that public funds are not invested in poorly constructed sewers which only last for a short time…“
There is nothing further to add to this.