

Management of the storage installations and adduction pipes in the SWDE

Jean-Pierre DEBLUTS
SWDE

Rue de la Concorde 41, 4800 Verviers, Belgium

Abstract

SWDE (Société Wallonne des Eaux) manage more than one million waterconnections laying through all the Walloon Region and use for this 1350 watertowers and reservoirs and also 3600 km adduction pipes.

The management of these infrastructures is a continuous challenge to maintain these installations in an optimum state and this to ensure the maintaining of the water quality.

One of the mean goals is to avoid corrosion of the used materials, even those concerning the pipes that those concerning the materials componing the buildings.

We must avoid at the same time the negative effects coming from outside, such as soil agressivity and AC corrosion and the negative effects coming from inside such as the effects produced by chlorine.

This presentation shows the methods and planifications that SWDE uses to reach this goal.

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Before presenting how SWDE (Société Wallonne des Eaux) manage his installations essentially regarding the repercussions of the problems of corrosion, let's describe shortly what is SWDE.

SWDE is an autonomous public company, linked with the Walloon Region by a contract of management. SWDE is the first water producer and water supplier in the Walloon Region and the covered zone is spreaded over all the territory of Wallonia. The highest concentration of the covered zone is situated on the west. The map beneath illustrates the covered zone.

The production and the distribution of water is organised on basis of an unique production departement covering all the company and distribution is organised on basis of 8 branches corresponding on 8 drainage basins.

Let us quickly quote some figures (based on the situation on 31/12/2011) to situate SWDE :

- 1.020.608 watermeters
- 2.381.095 clients
- 207 associated towns on 262 in the Walloon Region
- 1638 members of staff
- 26.718 km pipes (production and distribution)
- 157.862.982 m³ produced water
- 395.598.000 € turnover
- 399 water catchments distributed on 255 sites
- 1.354 storage reservoirs (reservoirs and watertowers) for a total capacity of storage of 594.000 m³

These figures show that SWDE is confronted to a great diversity of the managed installations with a great variety in the geographical repartition. Near urban areas like Mons, Namur, Charleroi or Verviers, SWDE covers also rural areas and forest zones, in Ardenne by exemple, where the density of population is very low. The sizes of the production installations are also very variable, SWDE managing great production center with a capacity of 100.000 m³/day but also little water catchments producing only 50 m³/day.

Having said that, in each case, the componants of the networks that SWDE must implement and manage are identical but variable in size and in dispersion.

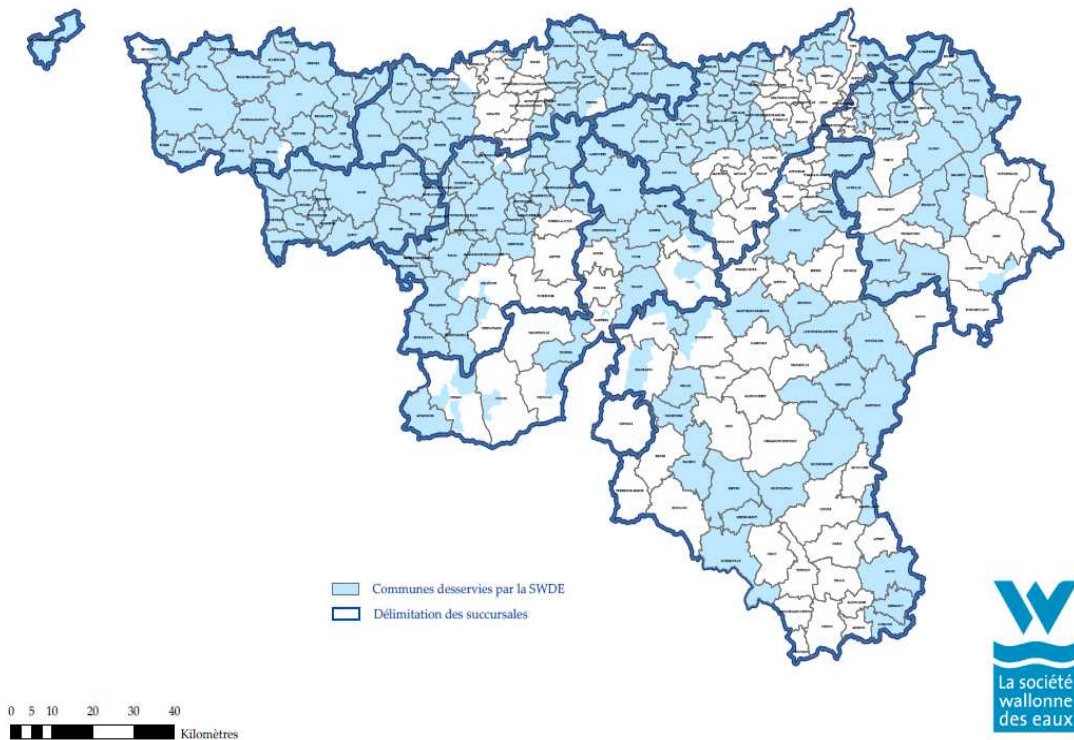
In the same way, the sizes of the storage reservoirs are variable, going from a capacity of 50.000 m³ for the biggest ones to 5 m³ to the littlest ones.

In each case, the main objective of the SWDE is to assure the supplying of water of high quality, in sufficiency and on a regular and continuous way.

We shall find below a general description of the criteria which must be taken into account, so much in quality of water, requirements bound to the construction of buildings (reservoirs, water towers, water treatment plants) or to their maintenance, requirements bound to the installation of pipes and cleaning of reservoirs which are generally implemented in the SWDE.

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Water quality

The degradation of the quality of the water can be due to the classical phenomenon of corrosion but also to number of factors such as:

- permeation
- backflow of water
- break of pipes
- incrustation
- infiltration
- products for water treatment
- disinfectants

- bacteria
- biofilm
- problems that occur in water treatment plants

The result is an increasing of the concentration of chemicals or bacteriological elements, concentrations that can reach the maximum limits, the creation of unwanted elements and the visible effects which can appear like color, flavour, odour or turbidity.

To contend risks linked to the degradation of the quality of water, several actions are taken as well on the level of the water production plants as on the level of the configuration of the installations intended for the storage and transportation of water.

We will not speak of the causes for which it's difficult to foreseen a structural protection, such as break of pipes and backflows where the protection must be situated inside the installation of the client.

It's also advisable to call back that external chemical attacks are not the lonely reasons that causes the degradation of the concrete and the coatings of the installations. Internal phenomenons may occur like carbonatation, osmosis, ...

In the same way, the behaviour of the watertight coatings may be deteriorated due to different causes like unhooking and blistering making certain fragile zones.

It is important from then to control regularly the physical state of the installations in order to repair them as soon as possible. It is necessary to watch in any case that a water produced by excellent quality sees this one degraded during its transport and its storage.

The investment policy of the SWDE in equipment and in maintenance of the installations of production and more particularly buildings which are associated to it (water treatment plants and pumping, reservoirs, water towers, ...) aims just as much at the new installations than at the maintenance of the existing installations. We can so consider that we count on average annually the construction of a new work of storage (for new needs or as a replacement for an existing work), 7 complete renovations of installations of storage and treatment and 50 partial renovations.

We shall examine below the technical approaches implemented in these various scenarios, while knowing that very often the practical, technical and architectural measures are linked with the management of the installations of production of water and transport.

When we shall speak about installations and about reservoirs, we shall understand both the reservoirs of foot and the reservoirs of head there

as well as quite other installation generally in reinforced concrete brought to contain some water as decanters and filters.

It is also necessary to retain that any intervention realized in a work exposes to two particular risks :

- a) The immediate risk connected to the creation of an incident with repercussion on the quality of the water. This incident is generally detectable immediately and its control and reparation can then be implemented quickly ;
- b) The deferred risk, connected to a degradation provoked during an intervention and which does not see itself immediately, what prevents then the resolution of this problem and what provokes in time an escalation of the situation.

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The realization of new installations

1. During the realization of new installations of storage, which we shall consider only in concrete, diverse architectural and constructive dispositions must be taken. These measures aim at guaranteeing the sustainability of the installation and thus at slowing down at most the corrosion of this one and at guaranteeing the preservation of the quality of the stored or treated water.

These measures consist in, by exemple :

- a) to assure a perfectly tight cover of the building to avoid the infiltrations of water ;
- b) to look particularly after a good realization of the joints ;
- c) to apply an effective and stable coating inside tanks ;
- d) to apply possibly a painting anti-condensation to the not immersed parts ;
- e) to assure a good insulation of the work ;
- f) to assure a good mixing of the stored water ;
- g) to watch that a minimum of natural light reaches the level of water ;
- h) to assure a good ventilation of the work ;
- i) to foreseen mosquito nets (double by preference) on the openings.

Concerning water treatment plants and more particularly filters and decanters in reinforced concrete, the criteria e and g above have less importance, the criterion f is excluded as for him

2. The choice of the implemented materials is also a point particularly important to take into account. They indeed guarantee the holding of the work and the holding of the quality of the water and they allow to slow down the corrosion of elements.
3. We know that the corrosion of concrete is a key issue of the good behaviour of the installations ; it is important from then to be able to implement products of waterproofness, that they are with mortar or with resins, which cannot only answer the criteria of drinkability, but which are also sustainable. Also the protection of zones not in direct contact with the water must be insured by so necessary painting. Paintings have to answer then the same requirements as the products of waterproofness.
4. The method of application must be especially also well adapted and well controlled during its application.
5. The attention on the implementation is particularly important, especially for the coatings of tanks as well as for the tender spots of the construction. Indeed, a wound of the cover or a defect of joint is a highway opened towards the corrosion of the armatures, so creating a phenomenon which will increase in time. The ideal is not to create such highways or at least to stop the distribution of the damages as quickly as possible, the costs of rehabilitation being exponential in time.
6. The attention must be also brought to the quality of the water able to be contained in reservoirs.
 - The emanations and the infiltrations of chlorine can exercise harmful incidences on protected concretes;
 - Aggressive waters bound to compositions of mixtures of water in the unfavorable carbo-chemical balance can also have fatal effects on the waterproof coatings.

In filters and decanters, the used products of treatment must be also well taken into account to define the most adequate covers.

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The deep rehabilitation of installations

1. We shall watch to adapt if possible the architectural and constructive measures quoted for the new installations. It is however clear that in case of rehabilitation, even deep, all the required elements cannot inevitably be implemented.
2. As for the new constructions, the choice of implemented materials is a point particularly important to take into account. They guarantee just as much the durability of the installation and the holding of the

quality of the water and they allow to slow down the corrosion of elements.

3. The products of waterproofness also follow the same principles as for the new constructions
4. The methods of application are also very important and even more than for the new installations. Indeed, it is the care brought to the renovation which will allow the installation to find a considerable life expectancy.
5. It is in this type of installations that we meet the interventions made necessary further to the degradation of materials creating the sometimes very deep corrosion of the concrete armatures. In that case, it is indispensable that the methods of treatment are very severe ; we can let remain on no account in the installations corroded armatures even a little bit corroded. It is necessary to replace them and assure passivation before beginning any concrete repair
6. It is also in this type of intervention that any fissure must be also handled, as well as the waterproofnesses of roofs. It is moreover necessary to watch that the possible fissures are suitably repaired before replacing the waterproofness, this last one not playing role of shutter of fissure.
7. In case of strong degradation of concretes, it is possible that the classic products of waterproofness cannot be set up because ineffective. If the repairs of fissures in a classic way or by injection are not effective, we can be brought to set up a cuvelage inside the tank. This one is generally with polyethylene, always provided with its certificate giving evidence of its compatibility with the drinking water.
8. A particular attention must be also brought to all the pipings or metallic infrastructures immersed in particular but also not immersed. We shall privilege the structures and pipes in stainless steel with a particular attention to the used quality of stainless steel.
9. We shall indicate finally that in the park of the installations of storage, we can find other types of construction that those in concrete in particular the metallic water towers. Here, it is advisable to be particularly attentive to the holding of this type of installation. Constituent steels of this one must be controlled regularly as well as their fixation on the ground, including by radiography. Any degradation of the steel must be treated as quickly as possible. The cathodic protection of the installation must be organized and watched sometimes consequently with attention.

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The partial renovations

It is here about more limited interventions which are located or targeted at a part of the building.

The same principles as for the heavy renovations prevail.

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The daily management

As evoked at the beginning, it is from the catchment of the water or to its treatment that a particular attention must be already brought with the aim of the protection of the continuous-flow installations.

The products of treatment and more particularly used oxidizing disinfectants, can have an incidence on the holding of the installations.

The use of chlorine can favor in certain cases the degradation of concretes by the liberation in the installations of storage of gaseous chlorine. The aeration of the works plays from then on an important role and it is advisable to verify regularly in such a case that this aeration is functional. Where necessary, this aeration can have to be forced.

The principle of aeration also allows to eliminate simple steam.

The permanent control by the remote processing of water treatment plants also gives guarantees of good running of the installations, allowing to react very quickly in case of failure. These failures can indeed have grave consequences as the unhooking of muds of a decanter.

The regular visual control of the installations also plays an important role. As indicated above, as quickly as possible an anomaly is detected, as quickly as possible she can be repaired, what avoids an escalation of the situation. During every intervention in a site, a summary visual control allows to raise some of these situations allowing to react quickly.

It is also necessary to underline the importance of the care of bringing to a localized repair. Indeed if a local repair is made, it is necessary to be very attentive to the fact that the junction between this repair and the rest of the installation in position is carefully made.

The daily management has to stay up also that a tank of storage or treatment does not remain empty. Indeed, if such was the case, the risks of fissuring of the structure are important.

But in the daily management of the works, we have to evoke the often grave incidences of the interventions of the operators of mobilophony. Indeed, these occupy regularly water towers to place antennas and relay

of communication. The fixations of masts and their stays, drillings of walls, even roof, are often at the origin of damages which can show themselves important.

It is from then on useful to be extremely watchful so that all the interventions realized within the framework of the installations of mobilophony are realized according to a project approved by the distributor of water, so that the implementation of the installations is made according to the rules of the art, and so that the works are scrupulously controlled.

We must finally note the importance in the daily management the budgetary planning both for the works of investments and for the maintenance works.

This budgetary planning is completed by a technical planning working with an effective management tool (ERP) which watches to register the demands of works, which plan the punctual interventions as well as the systematic operations of maintenance and which check that the works are finished well.

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The cleaning of reservoirs

The water transports constantly particles in suspension and it more or less according to the origin of the water and its circuit before succeeding in a reservoir.

These particles accumulate in the long run at the bottom of reservoirs under the form of more or less important muds.

This mud, if it is not in priori not annoying, can however be particularly fatal and it in several points of view :

- it can block certain pipes situated in bottom of tank
- it can recover in movement further to hydraulic turbulences and degrade the quality of the water
- it can favor the development of germs

It is for that reason that, generally, the producers of water proceed regularly to the cleaning of reservoirs. This operation can take place in a random way, what is the least favorable solution, in a purely curative way, or then according to a definite and strategic frequency. It is this solution which is recommended at the level of the SWDE. We must note that in certain countries, these cleanings and their frequencies are compulsory.

It is however advisable to be attentive to the implemented methodology to realize this working type :

- use compatible products with the drinking water (certificate of the product for contact with the drinking water is necessary)
- use soft methods of cleanings (a too rough method risks to damage inner coatings and consequently to create the beginning of corrosion of the concrete, then armatures)
- evacuate muds extracted in a statutory way
- ...

In the SWDE, a contract was set up to realize this type of intervention. The specifications which governs this contract includes all the useful requirements concerning the type of cleaning products used as well as the methods of cleaning used by the company in charge of the works. The frequency by default of cleaning of reservoirs is of 5 years.

This frequency can be however adapted according to the type of water and the local circumstances : she can be so increased in the zones where there is more production of mud and reduced where this production of mud is sharply lesser.

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Pipes

It is advisable to quote also the follow-up brought to the pipes which traces almost on that brought to buildings.

1. The choice of the constituent material of the pipe is important according to the use which is made. If it is sometimes in the free choice of the contractor in charge of works, it is sometimes indispensable to content itself to a precise type of pipe.

The nature of the ground agrees to be studied with attention to determine its possible aggressiveness. Of this study, a choice of material or coating can be made indispensable.

In any case, the pipes that are been placed have to be in perfect condition and answer completely the standards relative to these materials. We shall point out on this subject the importance of the reception of pipes and its accessories and to insist on the rejection of damaged pipes or not answering the total of the criteria.

An even bigger importance must be brought to the stainless steel pipes to choose and control supplied nuances of steel.

2. The implementation of the buried pipes is very important. The criteria of laying and protection of pipes must be scrupulously respected.

3. A particular care must be brought to the coating of the pipes which cannot be altered. No pipe should be hurt during the laying, and if such was the case, either she must be replaced, or repaired according to the rules of art.

The environment finally in which the pipe will be laid will have an incidence on the coating to be used to protect itself of an accelerated corrosion.

4. Also for the not buried pipes, the same care must be brought to coatings and to possible paintings of these pipes.
5. As for buildings, the quality of the water can have incidences on the corrosion of pipes. Of this reflection, the choice of the material and its coatings can depend on it.
6. Finally, the cathodic protection of certain steel pipes must be envisaged.

We shall not return on techniques already widely developed during previous congresses, but it is advisable to underline indeed the importance of this type of protection, the care of bringing to its conception and of the care that must be brought to its follow-up and its control, in particular during operations of cutting or repair.

It is necessary concerning this subject to be particularly attentive in case of cutting or of intervention on the pipes to make sure of the electric continuity of the protected steel pipes, of the insulation of devices and of the outside protection to be reconditioned after intervention.

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Application to the SWDE

The importance of the installations of production and storage of the water incited the SWDE for several years already to reserve consequent budgets both in investment and in maintenance of the installations.

Also, an important effort is realized at the level of the renewal of the pipes of adduction, effort which is again going to grow in the next years.

It is so that at the present time, we can count annually :

- The realization of a new work of storage and a new water treatment plant ;
- The full renovation of 7 works of storage and/or water treatment plants ;
- The partial renovation of 50 works of storage and/or water treatment plants

- The replacement of 0,8 % of the pipes of production

SWDE counts for the realization of these works on effective teams:

- A research department hardened to the studies of projects en this concerning every speciality ;
- A follow-up of the technologies of materials ;
- A policy of reception of materials ;
- Teams of exploitation of production ;
- Teams dedicated to planning using e.a. modules PM and MM from SAP ;
- Teams of controllers of the works ;
- Teams dedicated to the follow-up of buildings and to the operators of mobilophony.

In the short and medium-term perspectives, let us note an increase of the installations of pipes, a rationalization of the tool and a remote processing widened to the cathodic protection.

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Conclusions

The management of the quality of the infrastructures of production, adduction and storage of the water to guarantee the quality of the water involve a big attention on the daily management of the tool and the manufacturing process of the water. This management must be based on an effectiveness planning team which watch to the execution of works planned or on demand.

The chemistry of the water can indeed have a strong impact on the degradation and the corrosion of the installations. By an attentive control of the quality of the water and by consequence, the manufacturing processes, the used products and the control of the carbo-chemical balances and the aggressiveness of the water that we can reduce the impact of the corrosion of the installations.

The budgets assigned to the investments and the maintenance of the existing tool are essential. Every producer of water must be aware of the interest to have infrastructures in perfect condition and from then on to be able to intervene as quickly as possible to repair any degradation at the risk of seeing evolving these damages and either to return these irreversible, or to return the too expensive repairs.

A very rigorous care must be brought to implemented materials in the construction or the repair of the installations, but also in the way these materials are implemented. The rules of the art must be respected and the building supervision plays here a very important role.