The law 36/94 asserts the priority of water use for human needs, that good water quality has to be guaranteed and that reduced water consumption is a particular priority in order to permit renewal of the water resources. Consequently, an Agency has to focus on both the qualitative and quantitative aspects of the water delivered, while another priority is the tools for planning qualitative and quantitative actions. As regards the quantitative aspect, these actions include leakage reductions and the rehabilitations of deteriorated pipes; as regards the qualitative aspect, these actions include concentrated or spatially distributed treatments to guarantee the delivery of water with the qualitative characteristics requested by law.

The research unit (R.U.)of Ferrara intends to develop three topics relevant to the problems presented above. The first topic is relevant to the leakage reduction problem, whereas the second and the third topic are relevant, respectively, to the problem of scheduling pipe replacements and to the problem of achieving water quality characteristics within the water distribution system as uniform as possible.

As regards the first topic, the target is the development of equations with different levels of complexity in order to characterize the relationship between the water loss from a broken pipe and the pressure, the breakage typology and the pipe material. This research will be performed mainly through experimental tests using facilities which are already available at the Civil and Hydraulic Engineering Laboratory of the Engineering Department of the University of Ferrara, whose description is provided in section 14. The development of these equations will be performed taking into account the possibility of using them in hydraulic simulation models which in turn can be used to achieve control of the leakages.

As regards the second topic, the R.U. intends to develop a procedure for the optimal scheduling of pipe replacements and leakage detections in a water distribution system within a short-medium time window in order to minimize lost water volumes and breakage repair costs according to fixed available budgets. Finally, the development of the third topic is aimed at providing the positions and the optimal dosage for a fixed number and type of chlorine stations distributed in a pipe network to deliver water with qualitative characteristics requested by law, taking into account the temporal and spatial variability of the water demand at the nodes together with the uncertainty related to the quantification of the parameters characterising the chlorine reactions.

These last two procedures will be developed encapsulating multi-objective optimisation techniques, thus representing useful management instruments capable of explicitly considering several targets, usually conflicting with each other and characterizing the management of water distribution systems, as well as modelling techniques capable of representing relationships between pressure and node demands, leakages along the pipes, position and settlement of the regulator devices.

Finally, the procedures, initially validated with respect to case studies taken from scientific literature, will be verified through the application to real systems, with particular reference to the water distribution system managed by HERA Ferrara s.r.l., the Agency with which this R.U. has been collaborating for a long time.

For further information, visit the website of the research unit (R.U.) of Ferrara