# Newsletter

WANDA

January 2005

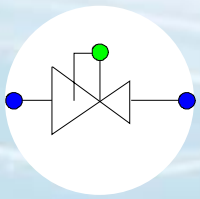
## New release 3.5

Recently all users with a maintenance contract have received the new version 3.5. They will find the following new interface feature: the possibility to create AVI files (movies) that can be embedded into a MS-Word or PowerPoint document. This offers a very powerful and interactive presentation of text, graphs and movies to your audience!
For our clients who prefer to work from the network a floating license manager becomes available offering access to the WANDA program via the server for all network PC's. Simultaneous use is limited by the number of client licenses. This floating license manager is an option.
A hardly visible but nevertheless important modification is the upgrade of the schematisation tool iGrafx professional: FlowCharter 2003. WANDA and FlowCharter form a rather unique combination because two individual programs are coupled. With the introduction of new operating systems during recent years an upgrade was required. Before releasing this update the FC2003 version has been tested and used internally. More regular upgrades of Flow Charter will be issued from now on.
On the component level six new functional components will be introduced: three elementary control valves for pressure and flow, a damper, a 2-way Resist and a so-called polynomial Resist. A short description of the new components is given further down in this brochure.

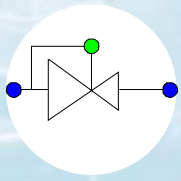
## Results of recent R&D activities

Last year we mentioned the start of the 3-years research project on the behaviour of air pockets in pressurised water pipelines. Together with the Delft University, 2 consultants and 15 waste water companies much interesting information has been collected and new insights have been obtained. To evaluate these insights, a transparent test loop with an internal diameter of 220 mm has been built during 2004 to carry out experiments on the behaviour of air pockets in different pipe configurations. A longer test loop (approximately 630 m) with an internal diameter of 235 mm is under construction and will be operational beginning of 2005. The first results of these research activities have been presented on the 4th International Conference on Sewer Processes & Networks (4th SPN), November 2004.
The results of these experiments allow us also to develop and verify two-phase flow calculation schemes.
In 2003 the 3-years Compass project has been completed leading to an advanced Decision Support System with several modules for (re)scheduling of networks, maintenance scheduling, operational control and redesign of networks.
The results of the EU-project on dynamic measurements of air valves (vacuum breaker/ air release valves) have been presented on the International Conference on Hydraulic Machinery in Valencia (April 2003), and on 26 September 2003 an international workshop with pipeline owners, manufacturers, consultants and researchers has been held. You can contact us for further information on these subjects.

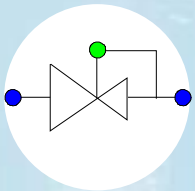
Dynamic air valve experiments: who needs a shower



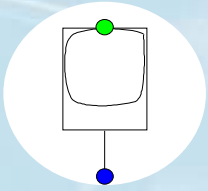
Flow Control Valve



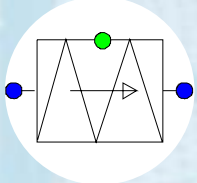
Upstream Pressure Control Valve



Downstream Pressure Control Valve



Damper, Bladder type surge vessel



Resist (2-way, polynomial)

wl | delft hydraulics

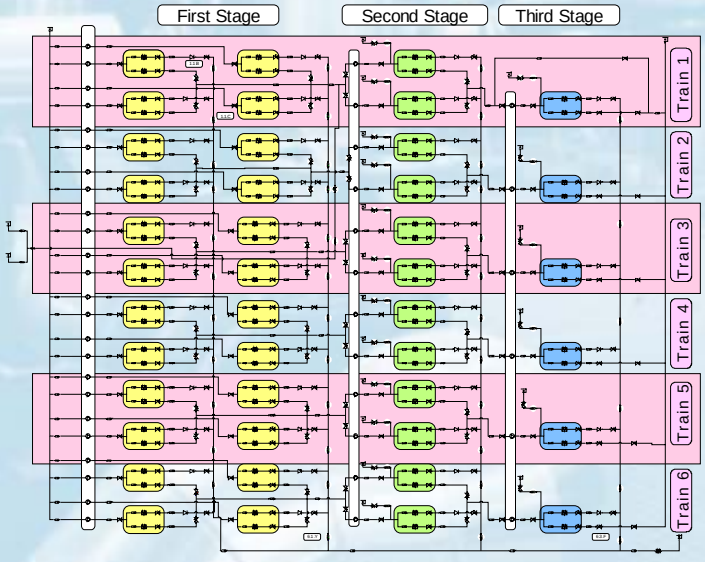
Transport of air pockets (parameters: flow velocity, pipe angle)

# WANDA developments

Coming years a lot of new modules and extensions of WANDA can be expected. In 2004 a smart solver has been developed that currently is tested internally. The solver achieves a considerable reduction of the calculation time for the steady and unsteady simulations. The reduction depends on the nature of the model: when the model includes large so-called nodel sets (combinations of all hydraulic components except the 'waterhammer' pipe), the calculation time reduction is easily a factor 10 or more. When the nodel sets are small and many pipes are included in the model, the reduction is less noticeable. Growing computer performance makes larger schemes possible, as well as so-called extended simulation runs. The combination of large schemes and long simulation runs can still result in relative long calculation times, together with large output files (several 100 of MB). Users of WANDA know already that they can reduce the size of the output files by increasing the so-called time increment from -standard- 1, to 10 or even more. This feature gives a considerable reduction of the output files, and also of the calculation time. In combination with the new smart solver (expected release summer 2005), the simulation time is (much) further reduced.
Another development is the unsteady friction factor of the pipe component. Most waterhammer codes do not or partially (as WANDA at the moment) account for the additional pipe friction phenomenae of secondary and tertiary pressure surges. This means that these secondary and higher order surges in reality damp faster than the codes show. Because the first pressure surge in most cases is the highest, this effect was considered less interesting. However in case of possible reflections of pressure surges in branched systems or networks the simulation results may be less accurate.

The pipe component will be modified to accommodate in the near future two-phase flow calculations. This modification of the pipe makes it possible to calculate with variable fluid properties of individual pipes such as density, vapour pressure or bulk modulus. This is the first step to a new Gas module planned for the coming years. The Gas module is complementary to the existing program modules for Fluid simulations. Necessary additions to components and input files will be included. The Gas module makes it possible to simulate all kind of gas transport systems with the same interface.

The running development on the Structural module is based on the existing program Flustrin: Fluid-Structure Interaction. This advanced program simulates pressures surges in pipeline systems as well as the mechanical response of the pipe in terms as displacements, (support) loads and stresses. This mechanical response of the pipe to a pressure surge can result in an increase of the initial pressure surge. The final result of such a physically more correct model consists of a more accurate dynamic calculation of the maximum and minimum pressures, as well as loads and stresses in a pipe. This particularly applies for pipe work above ground level as mostly used in plants of different kind, and most pumping stations. Because of required upgrades to the Flustrin interface as well as the Operating Systems, we have decided to add this important functionality to WANDA as a separate module. The WANDA window will therefore be extended with all relevant input and output properties to show the results in graphs or movies (displacements, loads, stresses).



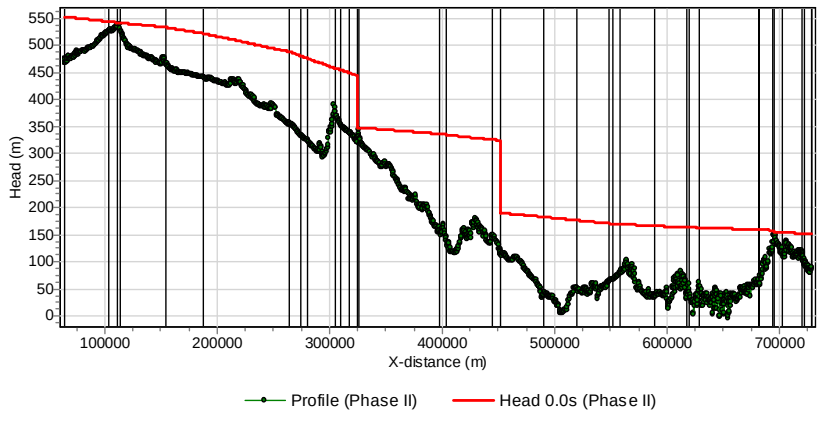

Schematisation of the Reverse Osmosis system

# Other activities

The Industrial Flow Technology departement has been involved in many pipeline studies of projects worldwide. Have a look on our Internet site:http://www.wldelft.nl/cons/area/ift/projects.html, and you will find some project descriptions of interesting systems:

- the new sewage water transport system including booster stations for the city of Amsterdam,
- the largest UF-RO plant in the world (22,000 $m^3$/h, Sulaibiya) in Kuwait,
- the new large Shuweihat transport system in Abu Dhabi,
- the dedicated hydraulic analysis of fire fighting systems in different tunnels.

Besides these simulation projects, field measurements have been realised, trouble shooting of different pump stations, model tests of different large pump sumps, hydraulic training activities, and many component measurements in our flow laboratory. Among the training activities are those for the engineers and operators of the GMRA systems in Libya, probably in volume the largest water conveyance systems in the world. At the moment the different GMRA systems consists of more than 3500 km of pipe with diameters between 3600 and 4000 mm. Detailed hydraulic knowledge is required to operate these systems, and WL|Delft Hydraulics is already for many years active for GMRA to train their engineers. In 2003 and 2004 two groups of GMRA engineers followed a training on pipeline hydraulics during 2 months. The diagram shows the Western Yamahiriya pipeline (hydraulic grade line and profile over nearly 700 km).




Western Yamahiria pipeline of GMRA (pipe profile and hydraulic grade line at million $m^3$/day)

# New components

Version 3.5 includes 6 new standard components: a Flow Control Valve, two Pressure Control Valves, a Damper, a 2-way Resist and a so-called polynomial Resist. WANDA Control users know that they can model any (complex) control valve by adding the required control loop to the valve. For users without Control module controlling of valves on flow or pressure is less easy. We have included in the new version one Flow Control valve that adjust and maintains the valve position to the specified flow rate, and two Pressure

Control Valves that do the same with controlling of the upstream pressure and of the downstream pressure. All types have a proportional control characteristic and show a linear valve position adjustment, using a proportional part of the full stroke closing time. It is also possible to limit the stroke of the valve between for example 30 and 70 % open for user specified valve characteristics. The damper or surge absorber is a surge vessel where the fluid is separated from the gas by means of a bladder or piston. The area of the vessel times the maximum height above the bladder specifies the maximum air volume of the vessel. This type of vessel is often applied in none-water systems where air preferably is not in direct contact with the fluid.

The 2-way Resist allows different friction loss coefficients for the positive and negative flow direction.
The 'polynomial' Resist makes it possible to specify a function of the type $\Delta H = A + BQ + CQ^2$. 'A' is a constant head loss factor, 'BQ' a user specific factor, and '$CQ^2$' forms the normal quadratic relation between H and Q for turbulent flow conditions. The user can compose his own relation by specifying 'A', 'B' and 'C'.

Sulaibiya UF-RO Plant (Courtesy of Ionics Italba S.p.A, Milano, Italy)

# Courses, user conference and workshops

From April 7 to 8, 2005 WL | Delft Hydraulics organises within PAO training courses a pressure surge course, on May 25, 2005 a user conference is held, and in Autumn 2005 a course on pumps will be held. These courses and the user conference are held in the Dutch language.
On a regular basis, WL | Delft Hydraulics organises also workshops in Dutch. If you are interested for your company or organisation in an English version of this workshop or one of our courses, please contact us. Some topics of workshops that can be organised by WL | Delft Hydraulics are:

- Efficient use of WANDA
- Dimensioning of air vessels
- Cavitation
- Vent
- Dynamic characteristic check valves
- Free surface flow pipes
- Control module

## More information

For more information, please contact:
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**WL | Delft Hydraulics**

Decisive advice: from multidisciplinary policy studies to design and technical assistance on all water-related issues.

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