ANALYSIS LABORATORY

ABOUT MM

MM Spa
is a leading Italian engineering firm specialized in the design and construction of public transportation infrastructure and urban redevelopment projects promoting the sustainable development of the local area.

Founded in Milan in 1955, MM is responsible for the construction of the city's entire metropolitan rail system - 108 stations and over 100 km of track - and for major traffic and hydrological engineering projects.

MM is now able to export the solid experience it has developed in this sector to other major projects throughout Italy and abroad. It has participated, for example, in the construction of the metropolitan rail systems in Naples, Rome, Brescia, Turin, Copenhagen and Thessaloniki, the light rail systems in Padua and Venice, and the Autostrada 35 (BreBeMi).

MM Spa offers services ranging from project design to technical and financial assessments, from preliminary characterization to work supervision, and from design validation to inspections, testing and quality control.

MM is now a business partner to public agencies on major public works, whose cost and complexity demand consolidated management capabilities and absolutely reliable technical and administrative support.

Since 2003 MM is also in charge of Milan's Water Supply Service, which includes abstracting, purifying and distributing groundwater, collection and treatment of municipal wastewater, and generally, planning maintenance and investments for the water supply and sewer systems.

In 2014, MM also undertook management of the real estate assets of the City of Milan, comprising over 38,000 subsidized housing units, parking garages and other facilities. To accomplish this, MM created the new organizational unit "MM Casa", which works alongside other company structures that are already managing city services.

MICROBIOLOGICAL ANALYSES

Since 1988 MM regularly analyzes water used for drinking, collecting samples along the entire system from extraction wells to the customer meter, and also monitors and tests supply-water treatment systems.

Monitoring is carried out to ensure compliance with water quality criteria established by law and to assess (since 2015) the presence of newly emerging micropollutants. Full compliance with standards of delivered water is also guaranteed via studies and monitoring of pollutants in both superficial and deep aquifer layers, the latter being the source of groundwater extracted for human consumption.

WATER SAMPLING

Properly executed sample collection methodology plays a decisive role in the reliability of analysis data. Thus all sampling is performed by technical personnel who are qualified to carry out the procedures required by the specific analytical methods that will be applied. A range of chemical-physical data is measured in the field using portable instruments and the data are then recorded and validated in the laboratory. The sampling plan, managed via WATER LIMS software, is determined on an annual basis and then submitted for approval to the Public Health Protection Agency, which is authorized to require analysis for specific added parameters not necessarily envisaged by laws, standards and norms in force.

MICROBIOLOGICAL ANALYSES

The MM laboratory uses standardized methods for microbiological analyses, both in analyzing for all microorganisms specified in drinking water legislation as indicators of fecal contamination (routine analyses) and in analyzing for certain opportunistic pathogens to provide a further layer of health protection for drinking water (special analyses). Enzymatic substrates that display a specific color in the presence of the target microorganism are used in the routine analyses and require no further testing to confirm the identification, thus minimizing analysis time.

The microbiological laboratory is equipped with a dual-laser flow cytometer. By using two specific fluorophores, one that can pass through the cell membrane (SYBR Green I) and another that cannot (propidium iodide), it is possible to assess bacteria vitality, separating them into living, dead, or damaged bacteria, as well as assessing their population density and dimensions. This information is of fundamental importance in managing the use of a disinfectant to ensure perfect water sanitation.

A laboratory luminometer is used in conjunction with the flow cytometer for ATP analysis. In a matter of minutes, both instruments provide information on the metabolic activity of bacteria found in the water sample (including non-colony-forming bacteria that elude detection via the traditional method of petri dishes).

CHEMICAL AND CHEMICAL-PHYSICAL ANALYSES

The laboratory is equipped to test for cyanobacteria (an emerging pathogen) in water samples from extraction wells by means of High-Performance Liquid Chromatography (HPLC). This analysis method makes it possible to verify whether there is a positive correlation between intracellular toxin content and chlorophyll attributable to cyanobacteria or test for the presence of cyanobacteria marker pigments.

CHEMICAL ANALYSES

- **Detection and quantification of herbicides, pesticides, pesticide-like products, polycyclic aromatic hydrocarbons (PAH), and flame** retardants via GC-MS with triple quadrupole mass analyzer;
- **Detection and quantification of aliphatic and aromatic volatile organic compounds** via purge-and-trap quadrupole GC-MS;
- **Quantification and identification of anions** and cations via ion chromatography.
  The choice of analysis methods and their application undergo a continuous process of review to remain abreast of drinking-water directives, standards and norms.
  Thus all instrumentation is constantly updated to ensure the highest degree of automation in analyses, thus increasing the accuracy and reliability of measurements.
  One example is hexavalent chrome: it is still one of the chemical parameters assessed using fully manual spectrophotometric methods but will soon be shifted to automated ion chromatography analysis.

METALS VIA ICP-MS

Metals are analyzed using inductively coupled plasma mass spectrometry (ICP-MS). The instrument is equipped with a collision/reaction cell to remove interfering ions. Given the relative chemical purity of drinking water, the laboratory is testing for very low levels and thus even trace concentrations of other ions can create interference in analyses.

CHEMICAL-PHYSICAL PARAMETERS

These parameters (some of them not among legislated drinking water standards) are fundamental for the initial characterization of water samples before continuing analyses with more sophisticated instrumentation.

ICP-MS

EMERGING POLLUTANTS

These pollutants are yet to be regulated but are of growing concern for their ecosystemic and human toxicity, ability to bioaccumulate, and persistence.
They are found at trace levels and it is only recently, thanks to the development of advanced instruments, that it has become possible to monitor and modify them.
Since 2015, the MM laboratory detects and quantifies pharmaceutical products and metabolites of industrial origin such as flame retardants, perfluorinated compounds, compounds of agricultural origin (pesticides and herbicides), and plasticizers.

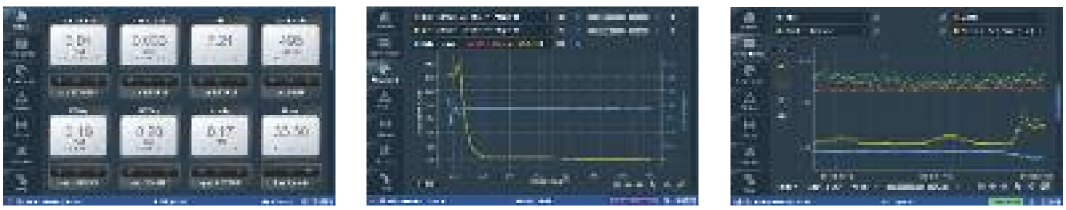
ONLINE MONITORING SYSTEMS

Over the years, MM has invested in researching online monitoring systems that can promptly detect sudden variations in water chemistry as envisaged in the drinking water risk assessment and management guidelines in the Water Safety Plans enacted with Commission Directive (EU) 2015/1787 of 6 October 2015.

While not required by law, MM analyzes for emerging pollutants as a standard practice in addition to testing for regulated pollutants.

The use of multi-parameter probes allows real-time monitoring of certain chemical and chemical-physical parameters that serve as indicators of non-conformity of water intended for human consumption.

The MM laboratory is equipped with an instrument that can perform online toxicological monitoring twenty-four hours a day. The instrument uses bioluminescent bacteria (Photobacterium phosphoreum) that are able to maintain a constant bioluminescent signal with constant sensitivity to toxic substances up to a maximum of ten days (they are particularly sensitive to heavy metals). If they come into contact with one or more toxic substances, they die and cease to be luminous.
By comparing the sample containing these bacteria with a control sample it is possible to calculate the mortality rate, which then indicates the concentration of the toxic substance dissolved in the water sample.



Monitoring systems

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