The appearance of legionella in the cooling system of a sugar refinery

30 November, 2000

Sillery (51)

France

Legionella
Sugar refinery
Cooling tower
Water
Pipes
Cleaning
Disinfection

THE INSTALLATIONS IN QUESTION

The sugar refinery is subject to authorisation, while the refrigeration facilities are subject only to declaration.

The closest housing, which is occupied by the personnel, is located 150 m from the cooling towers, while the nearest off-site housing is located approximately 400 m away.

Photo : DRIRE Champagne-Ardenne

As regards the regulations, the memorandum of 23 April, 1999 requested that specific provisions concerning prevention of the risk of legionella be required by a supplementary order of the prefect for establishments subject to authorisation that come under the heading of installations classed 2920 (compression-refrigeration installations), and cooling towers in particular, that are located in heavily populated areas or close to sensitive establishments (hospitals, day care facilities, etc.). As the Sillery site does not fall within this configuration, no specific provisions had been made by supplementary order of the prefect.

THE ACCIDENT, ITS BEHAVIOUR AND CONSEQUENCES

The accident

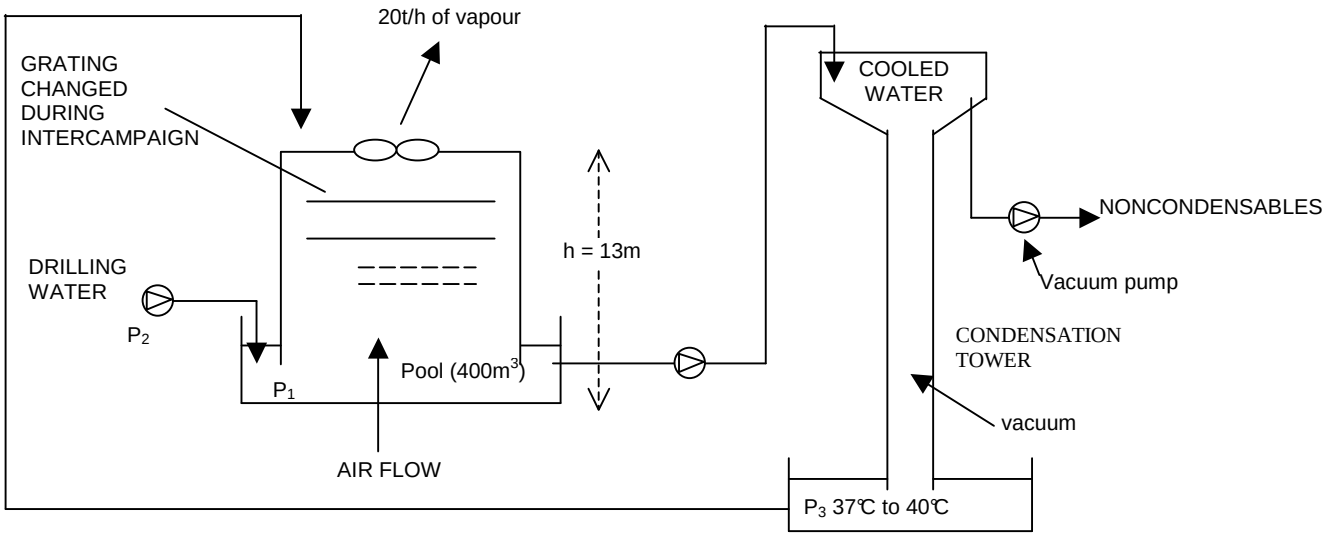
Within the framework of an internal procedure of the group, the operator of the Sillery site ordered that a legionella analysis be conducted in the cooling tower (performed by the CHROMOSOME regional hospital complex in Reims). On October 26th, 2000, samples taken on October 19th, 2000 revealed that there was no legionella present in the system. On November 24th, 2000, analysis of further samples taken on November 16th, 2000 revealed the presence of bacteria of more than 10^6 CFU/1 (colony-forming units per litre).

The DDASS (the French department of health and social services) learned of the incident through the press, who had been informed by someone who worked on the site. The DRIRE (the French regional inspectorate for industry, research and the environment) was informed, and a meeting was held on-site that evening, in the presence of labour inspectors, the occupational health physician, the DDASS, secretaries of the establishment-level works council and the CHSCT (the committee for hygiene, safety and work conditions), the site managers and the DRIRE.

As soon as the results of the analysis became known, the manufacturer decided to initiate treatment of the cooling tower as soon as possible. These operations began on November 29th, 2000 at 6 p.m. The treatment consisted in different steps:

- cleaning the system with a dispersing agent and a biocide for 48 hours, at a rate of 1-3 "shock" treatments per day (at a concentration of 100 ppm),
- complete purge of the system
- constant disinfection with a biocide over a period of 18 hours (at a concentration of 400 ppm).

It should be noted that the water in this system is used nor by the personnel neither for the production process.



Source : DRIRE Champagne-Ardenne

Analyses on the points of circuit P1 (in the pool at the foot of the cooling towers), P2 (on the makeup underground water inlet) and P3 (in the tank at the foot of the condensation tower) after decontamination (Saturday, December 2nd, 2000) were requested by the DDASS and DRIRE departments. The tests revealed that treatment had been effective.

Moreover, the personnel's lack of information concerning the risks involving legionella led to extreme anxiety amongst the employees.

European scale of industrial accidents

The Sillery incident did not involve any release of dangerous material (in the meaning of the SEVESO Directive) and did not lead to any human, social and environmental consequences. However, it had a financial impact, which, without any evaluation, could not be characterized with the scale made official in February 1994 by the Committee of Competent Authorities of the Member States which oversees the application of the 'SEVESO' directive.

The parameters that comprise these indices and the corresponding rating method are available at the following address : http://www.aria.ecologie.gouv.fr.

THE ORIGIN, THE CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

The sickness known as legionellosis or Legionnaires' disease is contracted by inhaling water contaminated by the strain Legionella pneumophilia diffused in an aerosol. Legionella (Legionella sp.) is bacteria present in the hydric environment. Belonging to the Legionellaceae family, it is Gram-negative, non-sporulating (non-thermoresistant) bacterium, strictly aerobic and highly mobile owing to their polar flagella. Among these bacilli are Legionella pneumophila, which is the primary human pathogen in this group, and Legionella jordanis and Legionella bozemani which have been isolated among immunodefficient subjects.

They preferentially develop between 20 and 45 °C and are destroyed in 2 hours at temperatures above 50 °C. Their optimal growth pH is between 6.8 and 7. Certain factors promote their proliferation, such as the presence of "biofilm", stagnant water, zinc, aluminium, high concentrations of calcium and magnesium, scale on pipes, rubber, PVC, polyethylene, and silicone…. Two substances play a major role in the bacteria's growth: L-cysteine, iron (ferrous Fe2+ or ferric Fe3+ iron) present in water or from equipment corrosion.

In water and the natural environment, the generation time is between 22 and 72 hours, while in optimal culture conductions, the doubling time is 3.9 hours. According to Professor Jérôme Etienne of the *Centre National de Référence des Légionelles* (CNR-L), the growth of legionella in a culture environment is slow: 60 hours in a liquid environment, 72 hours in a solid environment.

These aquatic bacteria are present in natural fresh water environments (preferably hot), in drinking water distribution system and air conditioning systems.

According to the laboratory conducting the analyses, the detection limit is 50 to 100 CFU/l.

It is an accepted fact that below 10^3 CFU/l, the risk of the sickness appearing is very low; starting at 10^5 CFU/l, the bacteria (Legionella pneumophila) can be responsible for sickness in humans.

The temperature of the water in cooling towers is between 37 and 40 °C. These structures are thus conducive to their development.

ACTIONS TAKEN

After this accident, different measures were implemented:

- ✓ The area around the cooling towers was marked out during the day, including the building in which the vacuum and circulating pumps were located. An internal memo from the management prohibited access to this area, as of December 1st, for all persons not wearing a respirator designed to protect against biological risks.
- ✓ If it became necessary to intervene on the cooling tower network, such operations were only to be carried out by trained personnel wearing personal respiratory protective devices. The head of the establishment issued specific instructions to that effect on the same day.
- ✓ As of December 1st, 2000, the industrial medical officer informed the personnel of the risks involved, the actions that should be taken if they suffered a health problem, and the tests and treatment necessary. He also personally interviewed an individual suffering from asthma. Moreover, any individual requesting a personal meeting with the industrial medical officer was granted one.
- ✓ The labour inspectorate informed the refinery manager and the CHSCT of the specific instructions to be applied as regards the entire body of on-site personnel (during the sugar harvest period, 140 seasonal employees work on the site) and as regards agents using respiratory protective devices.

As regards the regulations governing classified installations, applicable as of the beginning of the 2001 sugar harvest and subsequent harvests, a proposal for the systematic implementation of the provisions concerning the prevention of legionella, as provided for in the memo cited above, was presented to the departmental hygiene board of January 2001. A supplementary order of the prefect, taken in the framework of article 18 of decree 77-1133 of September 21st, 1977 retranscribed these provisions. It should be noted that they have been modified, the frequency of the analyses during the period in which the cooling towers are in operation becoming monthly, and not only at the time of cooling tower restart. On a regional level, the inspectors responsible for supervising sugar refineries and distilleries have been requested to do likewise.

LESSONS LEARNT

On the basis of this accident, the lessons that could be learnt and worth being highlighted are:

- ✓ To provide all personnel with clear information on the risks of the cooling towers and the legionella;
- ✓ To monitor the cooling tower systems and to perform regular analyses (the temperature of the water in the cooling towers corresponding to the optimal temperature at which the bacterium develops);
- ✓ Training members of the personnel for a potential intervention on the cooling towers;
- ✓ Obligation of wearing a respiratory mask when approaching high-risk zones.

It should be noted that the cooling towers are now Installations Classed for the Protection of the Environment (subject to authorization or declaration) regulated by the ministerial order dated Decembre 13th, 2004 and they must be controled regularly.