

RISK ASSESSMENT AS AN AID FOR THE PREVENTION OF *LEGIONELLA* CONTAMINATION IN ITALIAN TRAINS

1. Organisations involved

Italian National Institute for Occupational Safety and Health (ISPESL), Rome, (www.ispesl.it)

Rete Ferroviaria Italiana SpA, Occupational Health Service, Rome, (www.rfi.it)

Trenitalia S.p.A, Engineering Safety Direction, Rome, (www.trenitalia.com)

2. Description of the case

3.1. Introduction

Legionella is an ubiquitous bacterium that can create problems for public health; most cases of Legionnaires' disease are sporadic but hospital or community outbreaks can occur, such as those related to travel (in communal facilities like hotels, or on vessels such as ferries and cruise ships, etc.) [1, 2, 3].

Some studies have evaluated the potential risk of exposure to *Legionella* spp. in communal facilities (hospitals, schools, hotels, etc.) used as working, recreational or service premises and defined as 'indoor environments' in the 'Guidelines on Indoor Environments' issued by the Italian Ministry of Health [4]. Few papers have assessed the presence of the microorganism in the transport sector and none of them specifically in the railway sector.

Railway cars (also known as wagons or coaches) have tanks located under the car's roof and non-drinkable water is channelled drop by drop to the toilets and the galley kitchens. Passenger trains' water tanks are made of steel or resin and they may be of various capacities (from 200 to 1,800 litres).

Picture 1. Visual inspection of a water tank



Source: ISPESL

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This water must have the same specifications as for water for human use [5, 6]. These specifications might not be entirely fulfilled because of the characteristics of the hydraulic system. For this reason, water on trains is labelled as 'non-drinkable'. Tank water refilling is carried out through taps on the side of the rail track, and the tanks are emptied through other taps situated under the trains. During washing, decalcification or disinfection of the water tanks or the hydraulic circuits, high-pressure water is used and the workers involved are exposed to potentially infectious aerosols.

The Italian National Institute for Occupational Safety and Health (ISPESL) carries out research, training and standardisation, as well as providing consulting services and assistance to national bodies, public and private companies with regard to occupational safety and health. An agreement was signed between ISPESL and Trenitalia SpA (Italy's major train operator) in 2007 [7] and a study was carried out to evaluate the potential risk of exposure to *Legionella* spp. on trains and to promote measures for the elimination of *Legionella*. The Occupational Health Service of the Italian Railways (Rete Ferroviaria Italiana SpA) worked with Trenitalia's Engineering and Safety Department and ISPESL on this project.

3.2. Aims

The main objectives of the project were:

- To identify all potential environmental sources of the bacterium in railway cars in order to assess the risk of exposure to *Legionella* spp. for workers and passengers
- To ascertain the bacterial load in trains and compare it with the levels of contamination indicated by the Italian ministerial guidelines for the prevention and control of legionellosis [8, 9]
- To provide detailed technical procedures for biological risk assessment in the rail sector and to promote control measures according to the Italian law on health and safety in working environments [10].

Picture 2. Sediment and debris on walls and bottom of water tank



Source: ISPESL

3.3. What was done, and how?

In one year 521 rail cars were examined for *Legionella* bacteria in the water tanks. A total of 543 water samples were collected from the taps of the toilets and the galleys and examined according to the 'Italian Guidelines for the Prevention and the Control of Legionellosis' and the standard ISO 11731-2 [8, 11]. In 330 (60.8%) water samples either no *Legionella* spp. were found or low concentrations were detected ($\leq 10^3$ CFU/l). In the remaining samples, *Legionella pneumophila* and other species were present in various concentrations. In 28.9% of the samples legionella concentrations were higher than 1×10^3 CFU/l and equal or lower than 1×10^4 CFU/l. In 10.3% of the samples high concentrations were observed (higher than 1×10^4 CFU/l).

L. pneumophila serogroup 1 was isolated in 54.5% of the positive samples, followed by *L. pneumophila* serogroup 2 (24.5%). In the remaining samples, *L. pneumophila* serogroup 1 and 2 were present simultaneously (21.0%). This biological agent is classified in the second risk group according to legislative decree D.Lgs. 81/2008. According to Italian law [10] and the 'Italian Guidelines for the Prevention and the Control of Legionellosis' [8], in the case of high levels of environmental contamination, hygiene measures should be taken.

When the values exceeded 10^3 CFU/l, water containing 50 mg/l of chlorine was introduced for 60 minutes. Then the water was drained and several washings of the tanks were made with running water until the chlorine concentration fell between 0.7 and 1.5 mg/l. This range of values was used as a reference and a precondition for routine service. When water was changed every three to four days, bacterial concentration remained below the critical levels.

Microbiological checks were made before and after the disinfection in order to evaluate the effectiveness of control measures at regular intervals, according to the Italian guidelines: immediately after the chlorine treatment and, in case the results were negative, after 15–30 days, 90 days and, periodically, every 180 days [8].

In the case of high bacterial concentrations, disinfection was repeated, the tanks were cleaned and scale and debris were removed from the walls and the bottom of the tank. These measures were taken even in the absence of significant contamination, because bacterial concentration is subject to seasonal variations depending on the temperature in the water tank.

Personal protective equipment was given to workers assigned to the maintenance and the disinfection of the tanks, the repair of the hydraulic system and the cleaning of the water tanks. The focus was especially on work involving the formation of water spray. Workers involved were given FFP3-type masks with complete visors. Safety data sheets of all chemical products, disinfectants, detergents or additives used for sanitisation and disinfection was available for professional users together with descriptions of their job procedures.

All railway staff were trained on the risks from *Legionella*. Specific 'Guidelines for the prevention and control of *Legionella* spp. contamination in the water tanks of rail cars' were issued to the train staff working aboard as well in maintenance workshops, especially those dealing with water supply, hydraulic circuits, cleaning and repairing.

3.4. What was achieved?

- The sources of possible contamination from *Legionella* were identified through a programme of microbiological tests.
- Control measures were taken to protect workers in maintenance and in particular those dealing with water supply, hydraulic circuits, cleaning and repairing. Frequent water replacement in the tanks and periodic microbiological checks after water disinfection were adopted.



- Further measures including information, training and the provision of personal protective equipment were taken for workers who have a higher risk of contamination because of their particular job.
- Ad hoc guidelines were issued on the prevention and control of *Legionella* in the water tanks of railway cars.

3.5. Success factors

- Good collaboration among specialists in different fields (engineers, microbiologists, technicians)
- Special attention was paid to the fact that microbial concentrations are subject to seasonal variations

3.6. Further information

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3.7. Transferability

This initiative could be applied in similar work environments in the transport sector. In fact, the 'Guidelines for the prevention and control of *Legionella* spp. contamination in water tanks of railway cars' were presented at the Scientific Congress of the International Union of Railway Medical Services from 9–12 October 2007 in Brussels [12] and at the Second International Conference on Environmental, Industrial and Applied Microbiology from 28 November to 1 December 2007 in Seville, Spain [13].

3.8. Abstract

A working group of specialists from ISPESL, Trenitalia and RFI was set up in order to assess the risk from exposure to *Legionella* for workers and passengers on trains. Ad hoc guidelines for biological risk assessment and management on railways according to the Italian law (D.Lgs 81/2008) were developed.

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