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Vale Discloses Analyses of Water, Soil, Tailings and Sediment Collected from the Paraopeba River

Studies show that the river can be recovered; sediments were classified as non-hazardous to health

Two months following the breach of Dam I at the Córrego mine in Brumadinho, Minas Gerais, data from almost 300,000 analyses of water, soil, tailings and sediment collected from the Paraopeba river indicate that the river will be recovered. Environmental recovery depends on a set of actions, including the containment of solid tailings currently occupying the site where Vale's facilities were once located. Vale is designing a recovery plan for the Paraopeba river basin in collaboration with other companies, institutions and environmental agencies.

After the incident on 25 January, the company implemented detailed monitoring activities in the river, including daily water and soil sampling and turbidity level analysis. Currently, there are 65 monitoring points above the B1 breach site, located in the Ferro Carvão stream, in the Paraopeba and São Francisco rivers, in the reservoirs of the Retiro Baixo and Três Marias plants, and in eight other tributaries of the Paraopeba river. Tailings samples were collected from 30 points close to the B1 dam (including from dam) and from 12 points along the river.

The work - a compilation of 300,000 analyses carried out so far - is being carried out by four specialized laboratories hired by Vale and involves approximately 250 professionals. Vale hired the Coordination Department of Graduate Engineering Programs of the Federal University of Rio de Janeiro (Coppe-UFRJ) to evaluate the adopted methodology and validate the data already presented by the four laboratories.

The assurance that the river can be covered came from ecotoxicology tests that measured the effects of chemical elements in organisms that are sensitive to environmental changes, found along the Paraopeba basin and the San Francisco river, including the river mouth in the Atlantic Ocean. The technicians did not detect acute changes in any of the samples of the microcrustacean *Daphnia similis*. Tests with the bacteria *Vibrio fisheri* showed that the previous conditions are being maintained after the plume flow, being non-toxic in 97% of the samples. Regarding the fish contamination analyses, the results demonstrate zero toxicity for 100% of the samples collected from these aquatic organisms so far. Other analyzes in domestic animals and crops in the surroundings of the river and which have had contact with the water are underway.

"We deeply regret what happened, and we will do whatever it takes to recover the Paraopeba river basin, because we know that it is possible," said Gleuza Jesué, Environmental Management executive manager at Vale.

Containment of Tailings

One of the key factors to accelerate the recovery of Paraopeba is the containment of tailings. Vale is currently negotiating with environmental agencies to implement as soon as possible a plan to prevent the tailings from Dam I from flowing to the river. The plan includes the construction of four large structures - a dike, two hydraulic barriers and a sheet pile

retaining wall - in the basin of the Ferro do Carvão stream, a tributary of the Paraopeba river. The goal is to retain the remaining tailings mass in the river channel, which received the highest discharge of material from the Dam I, thus reducing the flow of sediments into the Paraopeba.

A stretch extending approximately two kilometers downstream of the Ferro do Carvão river mouth is concentrating large quantities of thick tailings and various materials, such as branches, which will be removed and disposed in a suitable location. Tailings will be dredged to help restore the water depth at the Paraopeba river, thus interrupting the flow of sediments. Finally, to help restore the quality of water of the Paraopeba, Vale started building a water treatment plant (WTP) to be installed 500 meters from the confluence of the Paraopeba river and the Ferro Carvão stream.

With a maximum flow of 2000 m³/h, the WTP will be equipped with decantation and filtering systems that can collect the water from Ferro Carvão and move it into the Paraopeba river with turbidity levels below 100 NTU (legal standard), in addition to meeting all the parameters laid down in the Resolution No. 430, of the Brazilian National Environmental Council (Conama), which governs the discharge of effluents in water bodies.

Turbidity

The results of the analyses carried out until March 21 indicate that the turbidity plume is in the reservoir at the Retiro Baixo plant, approximately 300 kilometers from the breach site. Points located downstream of this stretch show turbidity levels well below the legal limits permitted by law (100 NTU). Turbidity points are also correlated with increased concentrations of iron and manganese.

Once Vale agrees with the authorities and relevant agencies on the type of solution to interrupt the active source of sediment flow - in other words, the material deposited nearest the dam breach site - the flow of sediments will be reduced, thus contributing to restore the river to its (nearly) natural conditions.

According to technicians, the sediments from the dam breach will not reach the São Francisco river. This is because, despite preliminary flows, of the total tailings that entered the Paraopeba river, approximately 77% will be retained in the Retiro Baixo plant reservoir, while the remaining 23% will be kept in the reservoir of the Três Marias hydroelectric plant. Both reservoirs have a large capacity to retain the sediment, in addition to their dead volumes.

Water Supply

The distribution of piped water by water utilities that supply the cities along the Paraopeba river and the metropolitan region of Belo Horizonte remain unaltered. So far, Vale has distributed more than 37 million liters of water for human consumption, livestock and irrigation, covering 19 municipalities along the Paraopeba river basin.

However, as a preventive measure, the company has been studying options to strengthen the supply system and ensure water security for these populations, in the event of potential water shortages in the next periods of drought. One example is what is being carried out in Pará de Minas, whose water supply depended on the Paraopeba river. Some emergency measures have already been taken, including the reactivation of three water wells and improvement in the water pumping system in two other streams in the region. Drilling of new wells and surface catchment works are also underway.

By the first half of 2020, Vale will build a 50 km pipeline that will collect water from the Pará river (which has not been affected by sediments from the Dam B1) for directly supply to Pará de Minas. The expected flow will be 284 liters per second, the same quantity that the city collected from the Paraopeba river before the dam collapsed. In the future, with the recovery of Paraopeba River, this pipeline will double the capacity to collect water to supply Pará de Minas, becoming a legacy to the city.

Non-Hazardous Waste

Analyses of materials removed from four different points close to the B1 classified the tailings as non-hazardous to health. The toxicity levels are below the legal limits established for mining waste, as per NBR 10.004, of the Brazilian Technical Standards Association (ABNT). Two samples were classified as inert. Other two samples showed altered levels of solubility of iron, manganese and aluminum. These chemical elements are not considered heavy metals.

Technicians also identified the presence of heavy metals throughout the river, both in areas above the structure that collapsed and in sites below the Três Marias and Retiro Baixo plants, which had not been affected so far. Concentrations of arsenic, barium, lead, and uranium above the legal standards were found in samples up to 75 kilometers from the breach site, although the largest occurrence of these metals have been observed within 40 kilometers from the accident.

The presence of zinc in water samples is above the legal limits past the Três Marias plant, in different points and periods, located downstream of the current reach of the turbidity plume.

The comparison of the elements contained in tailings analyzed by Vale using historical soil geochemical data from the region, which were obtained in studies carried out by the Geological Survey of Brazil (CPRM), have shown that the levels of metals found in the tailings are of the same magnitude or lower than the maximum levels found in such soil geochemical studies. This indicates that the region is naturally rich in minerals that contain these elements, hence its inclination for mining activities.

Vale will continue analyzing the waste as the areas are cleared by the Fire Service. In the week of February 19, Vale collected 10 additional samples of material, five from the reservoir and the other five in the lowland along the Ferro do Carvão stream, with support from a helicopter. To obtain a more detailed spatial distribution of the tailings along the affected area, 20 new collections were performed near residences, farms and properties in general. These results will be available in the following weeks.

Paraopeba River History

The Special newsletter "Assessment of Historical Series between 2000 and 2018", published by the Water Management Institute of the State of Minas Gerais (IGAM) on 12 February 2019, evaluated the behavior of some parameters of Paraopeba River in eight monitoring stations operated by the agency. The historical series showed that, in rainy periods, the river's turbidity level surpassed in 18 times the legal limit permitted.

Over the years, IGAM specialists observed an increased presence of heavy metals - zinc, copper, arsenic, lead and nickel -, in levels above the limits set out by the environmental legislation for a Class 2 river, whose waters, according to the Brazilian National Environmental Council (Conama), can be intended for irrigation, recreation, fishing and human consumption after conventional treatment. Only the mercury analyses were within the legal standards.

Other non-heavy metals (iron, aluminum and manganese) were also above the limit. With IGAM's study, it is possible to draw a comparison of the quality of water before and after the breach of the B1 at the Córrego do Feijão mine, in Brumadinho.

More information



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