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Pit lake lime dosing: Assessment of the performance of the treatment based on a high-spatial resolution AUV survey

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The acidity of mine waters is typically corrected with passive (where possible) and/or active (i.e. chemical additions) systems. In the case of active treatments, lime dosing is a widespread technique due to the relatively ease of implementation and reduced operational costs. While neutralization of acidic waters is routinely performed in circulating water treatment facilities this is not so simple in open waters (e.g. pit lakes) because an efficient treatment requires the adequate distribution of the alkaline reagents throughout the volume of interest. To cope with this problem, a number of technical approaches have been proposed including active stirring (bubbling, etc.), surface spread diffusion, etc. In the early times of flooding of the Meirama mine, managers considered the necessity of lime dosing to correct the initially acidic mine waters. However, lake evolution proved that liming was not necessary and it was desirable to allow a reasonably unmanned evolution of the reclaimed system. In order to ensure that the lime dosing system is in good operative conditions in case of necessity, according to a prescribed time schedule to time mine managers put it in operation. That give us the opportunity to perform a large-scale "tracer" experiment useful to test the efficiency of wet lime dosing in a large water body. Dry lime, which is kept in a storage silo, is directly dosed over the channel of a small stream discharging in the lake. Therefore, stream water becomes saturated with lime and a pH of approximately 12.3. Stream water flows in cascade to the lake so that a certain potential and kinetic energy transfer is delivered to the lake. That promotes currents that enhance the re-distribution of the alkalinity load. In order to check for the distribution of alkaline water in the top body of the lake, an autonomous underwater vehicle (Yellow Spring Instruments Inc. EcoMapper AUV) was used. This device allows for the high-frequency simultaneous measurement of a water quality parameters (temperature, pH, electrical conductivity, dissolved oxygen, redox, turbidity and concentration of chlorophyll) according to prescribed trajectories at constant or variable depth. In the present study, depth was fixed at 1 m below the surface of the lake and two surveys were performed in two consecutive days. Results indicate that the efficiency of lime dosing is limited and, under windy conditions (i.e. when wind-transferred energy exceeds that of the currents associated with the liming system and others present in the lake), liming tends to preferentially concentrate at the leeward side of the lake.