Characterisations of mine tailings to explore their potential beneficiation into cementitious materials

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Mining industry is a crucial sector in the Australian economy; however, there is a growing concern about the environmental impact related to mine tailings which is a disposed waste product from the mining process. The utilization of tailings in construction has been proposed to resolve tailings-associated environmental issues. Although using tailings as aggregate has been investigated, the possibility of reusing these tailings as supplementary cementitious materials has not been thoroughly investigated.

This study explored the potential of several tailings to function as supplementary cementitious materials (SCMs) or precursors in alkali activation process. It is a spin-off from the TAILLIQ project (tailliq.com), funded by the ARC and six mining companies.

Several characterization methods were utilized to investigate the chemical characteristics of three raw tailings. Chemical compositions and mineralogical contents were thoroughly studied. In addition, their potential cementitious properties were assessed using the new 'rapid', 'relevant', and reliable' (R3) test methods. A trial hardening test of alkali activated tailings was then performed to correlate their results with the R3 test.

The characterization results indicate that the significant element in the gold tailings and copper tailings is silicon, which exists in the form of quartz. On the other hand, aluminum oxides and hydroxides crystalline phases were the main components in the bauxite tailings. The R3 test showed meaningful heat evolution generated from the bauxite tailings. This observation was consistent with the hardening test. Copper tailings showed the marginal potential to gain strength. Apparently, the stiffness of bauxite tailings mixture was suggested higher.