

Adhesive properties of coatings made of epoxy resin modified using quartz powders sourced from industrial wastes

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Introduction

Epoxy resin coatings are readily used as floor coatings. However, epoxy resin ingredients are very harmful to the environment, including are toxic to aquatic organisms, cause eye and skin irritation. Therefore, there is a need to find a solution to reduce the total mass of epoxy resin used to make the coatings. On the other hand, wastes from the extraction and processing of mineral resources are one of the largest waste streams in the EU [1]. An example is fine waste quartz powders. In this form they are hazardous because they often float in the air and therefore can cause pneumoconiosis. These powders will not be harmful when incorporated in solid epoxy resin. These powders must not deteriorate the durability of the epoxy resin coating, so it is required that the coating are characterized by a high pull-off strength (min. 1.5 MPa) [2]. The main aim of the research is to find the type and amount of waste quartz powder that will not reduce the pull-off strength of the epoxy resin coating.

Materials and Methods

The tests were carried out on a concrete substrate divided into two areas (raw and ground surface). The substrate was divided into 32 measurement squares. An epoxy resin coating was applied with a gradually increasing content of waste quartz powders (from 7% to 29%). Three types of waste quartz powders were selected with the same chemical composition (99.4% SiO₂) but with a different particle size distribution. The pull-off strength tests were carried out at three points on each measurement square in accordance with the ASTM D4541 standard (Fig. 1).

Results

The obtained average values of the pull-off strength are shown in Fig. 2.

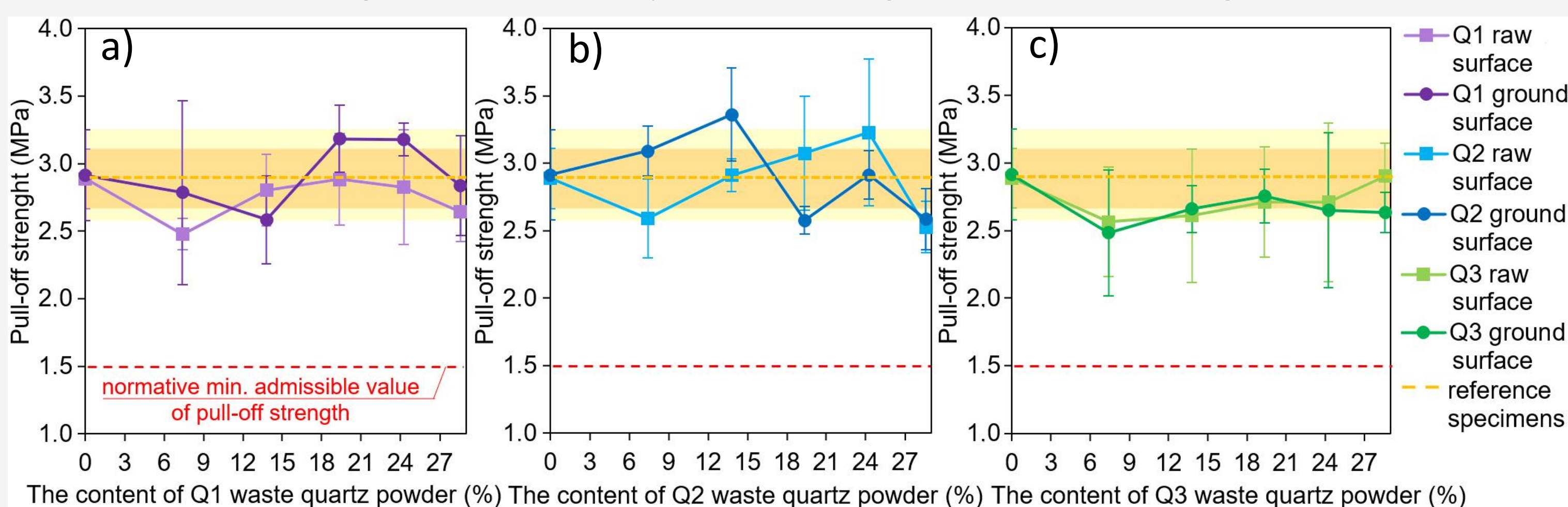


Fig. 2. The relation between the content of the waste quartz powder and the pull-off strength of coating for: a) Q1 powder, b) Q2 powder, c) Q3 powder

Conclusions

- The addition of waste quartz powders does not deteriorate the pull-off strength of the epoxy resin coating, the lowest average pull-off strength obtained is 2.48 MPa.
- The lack of mechanical treatment of the surface of the concrete substrate (raw surface) did not reduce the pull-off strength of the coating.
- Waste quartz powders can replace up to 29% of the epoxy resin mass in the coating without compromising the durability of the coating. Replacing a part of the epoxy resin mass will reduce the amount of hazardous ingredients in the coating and help recycle waste quartz powders.

References

- [1] Eurostat, 2021, Waste statistics, <ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics#Total_waste_generation> accessed 06.2021
- [2] Sadowski Ł., 2019, Adhesion in Layered Cement Composites, Springer, Cham, Switzerland.