Manufactured Sand and Slag Aggregate for Concrete Applications

This fact sheet advises on the use of sand and slag aggregates in low carbon concrete

Manufactured sand aggregates

Manufactured sand is purpose-made, crushed fine aggregate, which is a by-product of crushing rock aggregates in quarries and designed for use in concrete or road construction.

It can be used in structural concrete, non-structural concrete, concrete pavements, pavement base and subbase.

Benefits

- Minimises the extraction of virgin natural sand.
- Reduces the waste of low-value by-products in quarries.
- Business as usual in many geographical locations across Australia.

Considerations

Properties

- Finer than normal sand.
- Free from impurities such as clay, dust and silt.
- Denser particle packing.

Mechanical performance

- Similar to concrete with natural sand.

There are no key considerations related to durability and program for use of manufactured sand.

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Implications

Designer/ Specifier

- Concrete can have a slightly increased risk of plastic cracking, which can be mitigated with adequate curing.

Construction team

- Risks are low and manufactured sand is used regularly across NSW.
- Can impact workability and ability to achieve a high-quality finish in higher replacement levels (above 50%).
- Can require longer curing if shrinkage of concrete is higher to avoid plastic cracking.

Slag aggregates

Air-cooled Blast Furnace Slag (BFS) is a by-product of iron manufacturing. The slag exits the furnace as a molten stream at 1400-1600°C. If allowed to cool slowly, it solidifies to a grey, crystalline, stone-like material, known as air-cooled slag. This product is then crushed and screened to sizes suitable as coarse aggregate.

Suitable for use in structural concrete, non-structural concrete, concrete pavement, pavement base and subbase.

Benefits

- Reuse of a by-product as a replacement of natural aggregates.
- Can have lower shrinkage due to vesicular nature of the aggregate, which is a significant benefit.
- Can have lower heat of hydration.

Considerations

Properties

- Good grading.
- Higher water absorption, due to the vesicular nature of the aggregate.
- Density varies compared to normal aggregates.
- No forms of minerals that could cause alkali-aggregate reaction.

Mechanical performance

- No significant impact to compressive, indirect tensile and flexural strengths.

- Can have higher creep, which needs to be considered in the design.
- Can have lower shrinkage due to vesicular nature of the aggregate, which is a significant benefit for concrete.

Durability

- Can have lower shrinkage, which is a significant benefit.
- Can have lower heat of hydration, which is beneficial for large concrete elements or mass concrete.

There are no key considerations related to program for use of slag aggregate.

Implications

Designer/ Specifier

- Consider elements that are suitable to undertake slag aggregate due to higher density.
- Consider the potential of slightly higher creep.
- Consider the possibility of lower shrinkage in the design.
- Consider the availability and local supply.

Construction team

- Can cause higher slump loss and reduced pumpability due to higher water absorption. The use of admixtures or pre-conditioning in pre-mix plant may be needed to manage this.