CHAPTER 8

DISCUSSION AND CONCLUSION

As can be seen from table 7.7, the chemical requirements and moduli values of cement from spent shale were within standard limits and were close to the calculated values as follows.

C_3S and C_3A of cement from spent shale were lower than C_3S and C_3A of determining by calculation[21] 5.99% and 23.93% respectively. C_2S and C_4AF of cement from spent shale were 17.11% and 21.71% respectively higher than C_2S and C_4AF of calculation. These figures imply that the calculation can predict the obtained cement from spent shale with a fair agreement. The percentage of precision was at least 76%.

Comparing the results with Elephant brand cement, C_3S, C_2S and C_4AF were 4.77%, 8.43% and 13.25% lower respectively, only C_3A was higher than Elephant brand cement 23.35%. The lower amounts of C_3S and C_2S affect the strength of cement from spent shale by making it lower as well. The higher amount of C_3A should be avoided because it causes flash setting and makes the heat of hydration too high. Flash setting could be overcome by adding more retarders but the amount of retarders should not be over the limit. The effect of C_4AF in the cement resembled that of C_3A but it was not as strong as C_3A. The lower amount of C_4AF affects the colour of the cement powder too.

As seen in table 7.9, all the physical properties of cement from spent shale were within the limits of ASTM (Portland cement type I)

except fineness. This could be rectified easily by further crushing. Although the fineness was too low (2230 cm^2/gm), the other physical properties were in fair agreement. If the cement powder was ground more finely, the properties of strength and soundness would improve. It can be concluded that the cement made from spent shale can be utilized despite the fact that the degree of fineness was too low, reducing the cost of grinding.

The physical properties of cement from spent shale corresponded to those of Elephant brand cement. If the spent shale cement powder was ground to a fineness equal to that of Elephant brand cement, the physical properties should be better. But the time of setting would be more rapid.

The difficulties of x-ray diffraction occur because

1. The overlapping of peaks from different compounds, which makes it difficult to find suitable peaks.

2. It is possible that the patterns of the clinker compounds may differ significantly on account of isomorphous displacement which results in displacement of lines in the x-ray spectra.

However, x-ray diffraction results of compressive mortar cubes test corresponded to the theory, especially C_3S which attains the greater part of its strength in 7 days. On the contrary, C_2S produces little strength at early ages, but gains steadily in strength at later ages until it approaches equality with C_3S. From figure 7.5, the slope of C_2S should decrease more rapidly than this. According to theory, C-S-H should steadily increase. It may be that C-S-H changes to other products

when hydration occurrs. More details could be obtained from the x-ray diffractometer if the sample holder could be rotated. Since the area of the diffracted beam would be distributed more widely through the surface area of the sample powder. However, the x-ray diffractometer as a quick method of determining compounds is very useful.

Cement from spent shale was of a good quality due to the following.

1. All raw materials had a very good fineness, they were finer than 75 μm. Reactions could occur completely during burning because of their increased surface area.

2. The liquid phase value was high, so the raw mixture burned easily.

3. Spent shale has hydraulic properties.

Conclusion

1. Spent shale can be used to produce a good quality cement. The resulting cement from spent shale, using 25% spent shale, 72.15% limestone and 2.85% clay, resembles Elephant brand cement.

2. From Grün and Kunze's calculation, one can predict the resulting cement with 76% accuracy.

3. The maximum amount of spent shale according to Grün and Kunze's calculations can be increased to 34%.

Commence

Cement made from spent shale can be mixed further with spent shale to produce construction brick[24] and cement.[22] For example, spent shale mixed with Portland cement 10-25% by weight and compacted into cement blocks can be used for the interior construction of the building. And if spent shale is mixed with Portland cement at a higher proportion, for example more than 25% by weight, it can be used for both the interior and the exterior construction of the building.