Thermochimica Acta, 92 (1985) 349-352
Elsevier Science Publishers B.V., Amsterdam

THE INFLUENCE OF ANHYDRITE ACTIVITY UPON THE HYDRATION OF CALCIUM SULPHOALUMINATE CEMENT CLINKER

J.Majling , R.Znášik , A.Gabrišová , Š.Svetík

Faculty of Chemical Technology, Slovak Technical University,
812 37 Bratislava, Czechoslovakia

ABSTRACT

Two anhydrites were used in study with differing activities /according to specific surface, temperature of calcination and the rate of dissolution in water/.

The results indicate that the active anhydrite is necessary for the high rate of initial strength development.

INTRODUCTION

In the initial period of hydration of cement clinkers containing aluminate phases / $C_4A_3\overline{S}$, C_3A, C_4AF[+], .../ ettringite is formed / $C_6A\overline{S}_3H_{32}$ /. Additional SO_4^{2-} ions are necessary in the system to form ettringite quantitatively [1] .

In this work we studied the influence of added anhydrite on the hydration behaviour of cement clinker containing C_2S and $C_4A_3\overline{S}$ as main phases. The anhydrites differed significantly in their activities / specific surface, temperature of calcination, and the rate of dissolution in water /.

EXPERIMENTAL

The clinker was prepared from limestone, fly ash and gypsum at 1200°C. /Blaine surface 395 $m^2.kg^{-1}$/. Anhydrites were prepared by 1 hour's calcination of gypsum / $CaSO_4.2H_2O$ p.a. / at 800 and 1300°C /Blaine surfaces 630 and 390 $m^2.kg^{-1}$respectivelly/.

The cement pastes contained 10 wt.% of admixed anhydrites / w/c = 0.5 /. The hydration was studied by isothermal differential callorimetry 4 , x-ray analysis, TGA, DTA and by the measurement of pastes consistency by the modified Vicat method. Also the electrical conductivity of water suspensions of anhydrites was measured.

[+] $C = CaO$, $A = Al_2O_3$, $F = Fe_2O_3$, $\overline{S} = SO_3$, $H = H_2O$

Proceedings of ICTA 85, Bratislava

RESULTS

The phase composition of clinker is given in Table 1, the change in conductivity of water suspensions of anhydrites in Fig.1. / A8, A13 - anhydrites calcined at 800°C and 1300°C respectively/.

Table 1. Phase composition of cement clinker /wt.%/

C	-	1,87 wt.%
C_2S	-	65,4
$C_4A_3\overline{S}$	-	18.5
$C\overline{S}$	-	3 - 5
C_4AF	-	9 - 11
/ +minor.ph./ -		

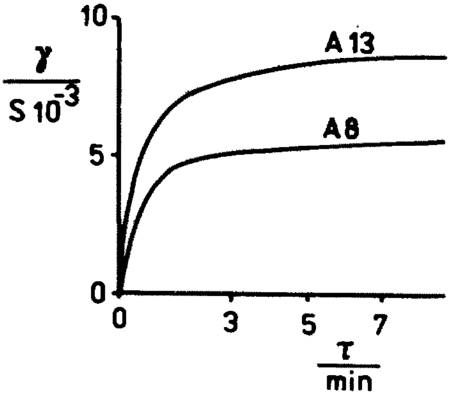

Fig.1. Time dependence of electrical conductivity of anhydrites water suspensions

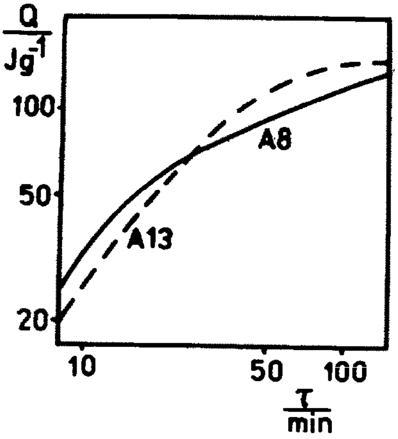

Fig.2. Cumulative curves of heat evolution in the system

Quantities of ettringite determined by GTA / after interrupting of hydration / are given in Table 2.

Table 2. Ettringite quantities after shown periods of hydration.

Time / hr /	0.5	1.0	1.5
Ett - A8 /wt.%/	12.9	21.8	24.8
Ett - A13	15.5	19.2	20.7

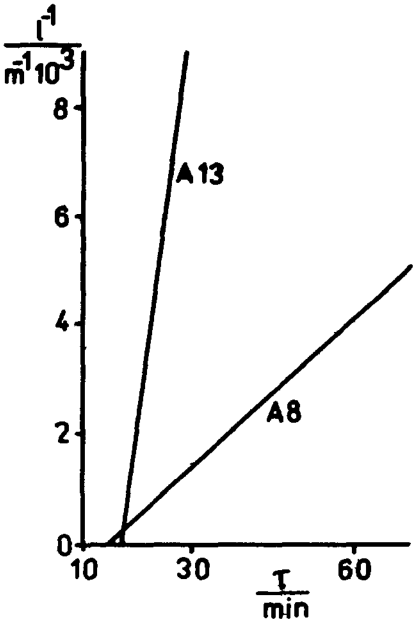

Fig.3. Effect of anhydrites on the development of paste consistencies

Fig.2. represents cumulative curves of the heat evolution in the system. In Fig.3. we can see the change in the reciprocal depth of needle penetration into the setting cement paste as dependent on the time of hydration.

DISCUSSION

According to Fig.1. anhydrites differ significantly in their rate of dissolution in water and the degree of resulted supersaturation of solution.

Ettringite is the only hydration product according to x-ray analysis, and also according to DTA [5] .

The change of the ettringite content in hydrated samples / as can be see from the Table 2. / gives similar dependence as given in Fig.2. The difference is in the time at which two curves intersects.In the case of calorimetric results this time represents ca 22 minutes, in the case of GTA ca 45 minutes from the beginning of hydration, respectively.

The time at which consistencies of pastes equal is still shorter / ca 17 minutes /, / Fig.2. /.

From these results it can be seen that the increase in the consistency in only partially dependent on the amount of ettringite formed. That the anhydrite with higher activity inhibites first reaction of ettringite forming more profoundly then the anhydrite with lower activity. In the next period of hydration the more active anhydrite accelerates hydration and strenght development in a more intense manner.

It can be infered from results that the active anhydrite is necessary for the high rate of initial strength development. The proper activity of anhydrite can be adjusted by its thermal and mechanochemical activation.

There is the indication that the increase in the consistency is contributed also by morphology of the reaction product. It is expected that the low activity of sulphate phase does not promote the solution mechanism of ettringite formation.

REFERENCES

1. Thiel A., Cement Wapno Gips, No 4, 104-109 /1983/
2. Larkin E.E., Mander J.E., Adams L.D., Cem Concr. Res.,4, 533-544 /1974/
3. Majling J., Hrabě Z., VI. Symp. Sci. Res. in Silicate Chem., /V.Lach. edit./ Brno 1984
4. Oliew G., private communication
5. Odler I., Abdul-Maula S., Cem. Concr. Res., 14, 133-141 /1984/

AKNOWLEDGEMENT

We are thankful to G. Oliew from ZIAG Berlin / calorimetric measurements / and to E. Bobová and E. Isteníková / x-ray and electrical conductivity measurements /.