Absorption of water and carbon dioxide in carbonated glass fabric

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The object of research was industrially produced fabrics of Na-Al-Si glass fibers. It is known that Na+ ions diffuse to surface of fibers [1] and due to reaction with H_2O and CO_2 from atmosphere form here the thin (about 1μm) carbonated shell [2], consisting of trona $(Na_3 H(CO_3)_2)·2H_2O)$ determined by thermo gravimetric analysis. The investigations showed [2], that the experimental weight uptake–time $\Delta M (t)$ curves for the beginning period up to some tenths of hour after heating of samples are well-fitted ($R^2 > 0{,}99$) to regression of

$$\Delta M (t) = A_0 - A_1 \exp (-t/t_1) - A_2 \exp (-t/t_2). \qquad (1)$$

A_0, A_1, A_2 in (1) are weight constants and t_1, t_2 are time constants ($t_1 \leq t_2$), $\lim \Delta M(t)=A_0$ when $t\rightarrow\infty$ and $\lim \Delta M_1(t)=A_1\exp(-t/t_1)= A_1$, and $\lim \Delta M_2(t)=A_2$, when $t\rightarrow0$. In relation $A_0=A_1+A_2$.

The current work was devoted to explain the meanings of parameters in relation (1) and using the relation (1) to explain the weight uptake processes. The different fabric weight recovery atmospheres showed that the first component (with shorter t_1) of relation (1) is sensitive to concentration of CO_2 and second one to H_2O. The weight recovery by CO_2 is much more fast compare to H_2O ($t_1<<t_2$), but amplitude of weight recovery is many times less ($A_1<<A_2$). The time constants (t_1, t_2) and amplitudes (A_1, A_2) of both absorption processes highly increase after heating of samples at temperatures over beginning of decomposition of trona before. The reasons of observed dependences there are discussed.

The high degree of coincidence ($R^2>0.999$) of experimental points and regression function indicates to successful use of method to investigate the absorption processes in similar structures.

References

[1] B. W. Veal, D. J. Lam and D. P. Karim, J.Nuclear technology. **51,** 136 (1980)
[2] E. Pentjuss, A. Lusis, G. Bajars and J. Gabrusenoks, IOP Conf. Series: Materials Science and Engineering. **49** 012044 doi:10.1088/1757-899X/49/1/012044 (2013)