PERGAMON

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Author's response

We would like to thank the commentator for his interest and contribution. Knowing that people other than the referees have paid attention to our work is always a great pleasure. However, the commentator somewhat missed the point of the original paper.

1. Role of shrinkage

The commentator claimed in Comment 1 that the "centrifugal dewatering" stage of the highly impermeable cake was erroneously attributed to the removal of water from pores and by "air drying". The suggestion followed from the understanding that the experimental setup could not allow a substantial pressure gradient to be applied and allow the drying air to flow through the highly compressible activated sludge cake. In the commentator's opinion, the cake shrinkage caused by the unbalance of pressures across the menisci at the gas–liquid interface was responsible for the observed dewatering. The commentator had applied this understanding to interpret the filtration dewatering data [1,2].

The flow fields of water in unsaturated cake are very complex. Our original paper had not claimed that the centrifugal dewatering of activated sludge was governed by pore water removal and air drying. In fact, the only statement made in the original paper concerning "air drying" is in the Introduction, addressing the Schubert's [3] general classification of the centrifugation of suspension. Our work primarily concerned both the inadequacy of applying conventional centrifugal filtration theories to the investigated, conditioned activated sludge samples for significant sedimentation effects, and the existence of an "optimal"rotational speed resulting from the change in cake structure. We agree with the commentator that the examined centrifugal force might be too small to induce the passage of air through the cake; but no contradictory claim was made in our original work. In addition, Dick and co-workers qualitatively described the impact of the shrinkage force in cake dewatering. No quantitative analyses had been previously performed. Experimental findings are inconsistent with the action of the shrinkage force. For example, the cake collapse (shrinkage?) with original and conditioned sludges occurred not *after* but *before* the merging of the interface, GL and cake surface, SC, at which point the capillary force became significant (Figs. 5 and 6 in our paper). Apparently, several factors, possibly including shrinkage, affect centrifugal dewatering.

2. Implications for centrifugal dewatering

Again, our paper did not claim that the results obtained with the investigated arm-suspended centrifuge correlated directly with those obtained with industrial centrifuges. We agree with the commentator that the flow and force fields in both devices differ greatly, and cannot be directly linked. The original paper only offered a general comment, in the final paragraph (p. 2383) that sedimentation effects should be more profound in the industrial centrifuge devices since such devices can provide higher centrifugal forces than the present arm-suspended centrifuge. The application of conventional centrifugal filtration theories to dewatering flocculated activated sludge is challenged.

3. Summary

In sum, the original article had not claimed that air drying corresponded to the centrifugal dewatering of activated sludge. The cake shrinkage proposed by Dick and co-workers may affect the centrifugal dewatering of flocculated activated sludge; however, no quantitative experimental evidence justifies its participation in cake dewatering. Secondly, the present results had not been extended in a Lab-scale arm-suspended centrifuge to industrial applications. The authors believe, however, that the sedimentation effects should be greater in real applications than in Lab-scale tests.

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References

[1] Dick RI, Wells SA, Bierck BR. Note on the role of capillary forces in compressible cake filtration. Fluid/Particle Sep J 1988;1:32–4.

[2] Bierck BR, Dick RI. Mechanisms of compressible sludge cake shrinkage. J Environ Eng 1990;116:663–82.

[3] Schubert H. Capillary forces—modeling and application in particulate technology. Powder Technol 1984;37:105–16.