

Perrhenate and phosphate

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9 April 2010

Possible interaction between perrhenate and phosphate

The question is: does the phosphate buffer have any bearing on the solubility of ammonium perrhenate? I have searched the literature for interactions between perrhenate and phosphate. There is very little and no evidence of an interaction which would reduce the solubility of ammonium perrhenate.

It is worth noting that perrhenate and phosphate are both tetrahedral oxoanions and I would expect them to have similar binding properties to cations and positive binding sites and so to compete in binding to such sites. I have found three papers which suggest that perrhenate and phosphate have similar binding properties.

(a) Sutton, A.D., May, I., Sharrad, C.A., Sarsfield, M. J., Helliwell, M. L., Dalton Transactions, 5734-5742 (2006). The coordination of perrhenate and pertechnetate to thorium(IV) in the presence of phosphine oxide or phosphate ligands

Perrhenate and triethylphosphate compete for coordination to thorium(IV).

(b) Anusuya, B., Murty, V.S., Rama Rao, K.V.S., Subramanian, S. Journal of Molecular Structure, 372, 41-47 (1995). ESR investigation of the phosphorus-rhenium center in γ -irradiated phosphate-doped ammonium perrhenate.

Ammonium perrhenate doped with potassium dihydrogen phosphate formed crystals with the same x-ray parameters as ammonium perrhenate with some substitution of perrhenate by phosphate, i.e. perrhenate and phosphate are interchangeable.

(c) Semenov, M.I., Blokhin, A.A., Taushkanov, V.P., Journal Of Applied Chemistry Of The Ussr, 58, 1334-1337 (1985). Exchange Kinetics Of Perrhenate, Tungstate, And Phosphate On The Hydrated Oxides Of Quadrivalent Metals.

Is there evidence of a phosphate and perrhenate interaction in the respiration test?

I have looked at the Report to evaluate the possibility that phosphate might interfere with perrhenate. I have tried to calculate the composition of the test solutions from the description of how the solutions were made up. The procedure is not entirely clear and the authors of the study should be asked to provide data on the molar composition of the test solutions. However my estimate of the concentrations from the descriptions given is

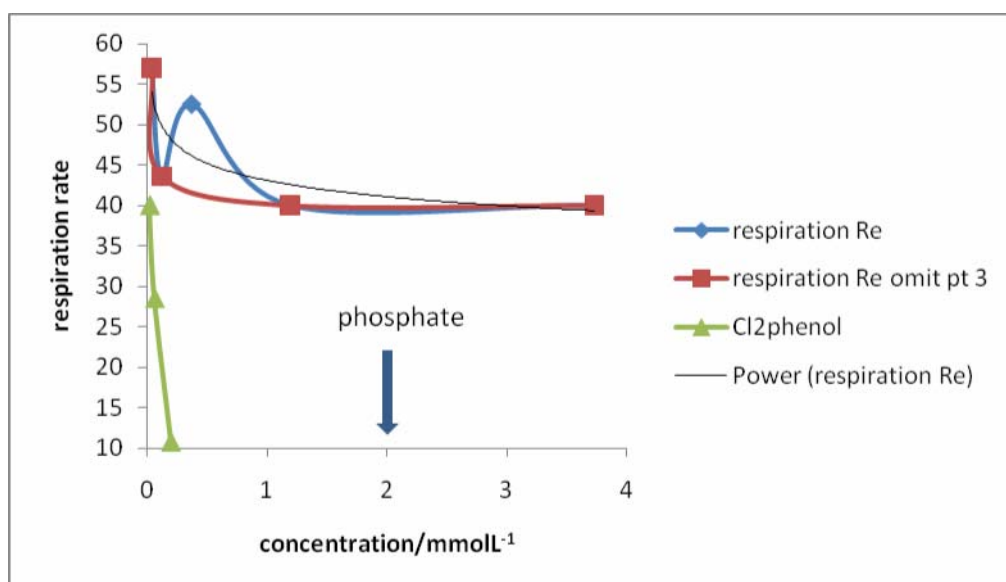
Phosphate concentration (as total phosphate irrespective of protonation):

2.01×10^{-3} mol/L or 2.01 mmol/L.

Rhenium concentration as perrhenate:

mol/L	mmol/L
3.72846E-05	0.037285
0.000119311	0.119311
0.000372846	0.372846
0.001193108	1.193108
0.003728463	3.728463

We see that for all perrhenate concentrations except the highest the phosphate concentration exceeds the perrhenate concentration. From Table 20.1 of the Report we see that increasing perrhenate does cause some decrease of the respiration rate (best seen from a plot of rate vs Re, see figure) so phosphate even in ca 100 fold excess does not block perrhenate. The inhibitory effect of perrhenate is evidently less than that of 3,5-dichlorophenol.



Possible interaction between perrhenate and cations in the buffer

We might note also that the buffer solutions contain cations (Ca, Mg, Fe(III)) which could interact with perrhenate.

CONCLUSION

A large excess of phosphate does not block inhibition by perrhenate. A reasonable conclusion is that phosphate does not remove perrhenate from solution. The only way of checking this is to do the test in the absence of phosphate.

