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Chemical transients in closed chaotic flows: the role of effective dimensions

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We investigate chemical activity in hydrodynamical flows in closed containers. In contrast to open flows, in closed flows the chemical field does not show a well-defined fractal property, nevertheless, there is a transient filamentary structure present. We show that the effect of the filamentary patterns on the chemical activity can be modeled by the use of time-dependent effective dimensions. We derive a new chemical rate equation, which turns out to be coupled to the dynamics of the effective dimension, and predicts an exponential convergence. The predicted asymptotic behavior and the initial non-exponential growth of the chemical product can directly be checked in experiments. Previous results concerning activity in open flows are special cases of this new rate equation.

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