This Week's Citation Classic

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Thiele E W. Relation between catalytic activity and size of particle. *Ind. Eng. Chem.* **31**: 916-20, 1939

The article points out that a porous catalyst grain cannot be fully active unless the reacting fluid can diffuse to the interior, and the products diffuse out, in a time shorter than the reaction time. It presents a criterion to determine when a catalyst grain is small enough to permit full activity. [The *SCI*® indicates that this paper was cited 227 times in the period 1961-1977.]

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"In 1923-25 I was working on my doctor's thesis on the reaction of steam with carbon. The results were quite unexpected, and among other things I gave much thought to the possible effect of the porosity of the carbon specimens I used. However, the porosity did not turn out to be important in the results, and I did not develop a formal theory.

"I then was employed by Standard Oil Company, Whiting, Indiana, and spent some years in various chemical engineering projects. In 1935 I was abruptly assigned as supervisor of the company's research and 'development work on catalytic processes, and found myself getting up to date on various matters that I had not considered since my school days. Among other things, it was obvious to me that catalyst grain size might be important, and I looked through the literature for guidance. To my surprise, I found practically notning, and so undertook in my spare time to supply the lack by calculating what the effect would be for various possible cases

"My calculations of course proceeded slowly At one point, I tound it necessary to use elliptic functions, a mathematical tool of which I knew hardly anything. There was a good small book on the subject, out of print in this country. I ordered a copy from England, and so completed my paper.

"Meanwhile, in 1937, some of what I was looking for was published by Damkohler in a big chemical engineering encyclopedia. I had kept a sharp eye on the current literature, but who looks for new stuff in an encyclopedia? I did not know of his work until much later. Also, Zel'dovich in Russia published results similar to mine in the same year as my paper; this also I found out later.

"I presume that most of the readers of the paper said: Of course, of course ' Some, I fear, looked at the numerous equations and thought: 'This is too rich for my blood' and passed on, although I had been careful to put the mathematics in an appendix.

"The paper described no experiments, and for quantitative use required physical constants which were not available. So various interested workers undertook experiments to determine these constants. This turned out to be much more troublesome than might be expected, and the considerable amount of work and its discussion are no doubt one of the mam sources of the many citations. Also, the original theory called for a constant temperature process, and studies, both theoretical and experimental, on the effect of temperature are another source of citations It is also pertinent that interest in catalysis has grown greatly since 1939.

"On the whole, I might say that the paper brought to general attention for the first time a consideration that almost every researcher in catalysis must have in mind, qualitatively, but that the problem of calculating the effect in advance of experiment has proved rather intractable."