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Heinz Heinemann. The Berkeley Years (1978-1993)

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Heinz Heineman came to Berkeley in 1978 and stayed there for 15 years. This was the time of the energy crisis and we did not have anybody like him who had such a tremendous industrial experience with oil and coal conversion technology and science. He was interested in the conversion of coal to gaseous molecules and our studies with model catalysts appealed to him and attracted him. In a way, Heinz Heineman was bigger than life, since he played such a seminal role in the history of American catalysis science.

Running title: Heinemann. The Berkeley Years

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I. Introduction

Catalysis sciences dates back to the 1930ies with Vladimir Ipatieff, Herman Pines, Eugene Houdry, Paul Emmett, Keith Hall and Hugh Taylor, who had established the fundamental phenomena by focusing on motor fuel production by catalytic means, the CO hydrogenation reactions, ammonia synthesis and some of the fundamental phenomena that led to the definition of active sites in heterogeneous catalysis. This period was followed by the industrial might of the petroleum industry, Vladimir Haensel of Universal Oil Products Co, Jules Rabo of Union Carbide, Otto Beeck at Shell, Paul Weiss at Mobil, John Sinfelt at Exxon, Tom Hughes at Chevron, and others, who focused on catalytic conversion of fuels to high-octane gasoline and diesel fuels. The presence of a Dutch component in American catalysis science was caused by the relocation of much of Shell's research from the Netherlands because of the German occupation, to the United States.

II. Catalytic research of Heinemann in Berkeley

Heinemann (Figure 1) was an industrial scientist in this very period. After a long period of industrial research with Kellogg he moved to Mobil and retired from the company just before coming to Berkeley. During this period, catalysis science performed

so excellently in industry declined and the field moved to centers in academia, and Berkeley was one of them. He employed and worked with 12 postdoctoral fellows over a 15 year period who are maintaining their activity even at present.

He started to work with graphite as a model carbon solid to study the catalytic gasification using potassium hydroxide as a catalyst^[1, 2]. He found at relatively low temperature at 800K hydrocarbons from C₁ to C₆ could be formed with high efficiency as shown in Fig.2. He worked on the mechanism and found that the carbon bond next to the OH bond of potassium hydroxide had to be broken as the rate limiting step to produce products of CO and hydrocarbons.

He found other catalysts also worked for carbon gasification at 900K using mixtures of potassium hydroxide and oxides of transition metals as catalysts^[3]. Out of these transition metal mixtures, iron oxide and nickel oxide were the most efficient and had the highest activity. Electron microscopy studies revealed that potassium hydroxide alone as a catalyst channeled into the graphite and at the end of the channel the potassium hydroxide dissolved the carbon, which then gasified. When a transition metal was used, both edge recession and channeling into the graphite was observable. Following the work with graphite as a model catalyst the steam gasification with chars was studied at temperatures below 1000K using a potassium oxide - calcium oxide catalyst, which shows superior resistance to deactivation by sulfur^[4, 5].

Heinz Heinemann in the 1989-90 period turned then to the conversion of methane by oxydehydrogenation using catalysts such a calcium, nickel or potassium oxides at low temperatures, below 600 °C^[5]. We found catalytic oxidative coupling of methane to

produce C₃ and C₄ paraffins and olefins under these circumstances. Oxydehydrogenation was the focus of his work for these remaining years in Berkeley^[6-10]. He pursued that with mechanistic studies using oxygen isotopes to study isotope exchange to reveal the mechanism of oxydehydrogenation and utilized other catalysts such as ZSM-5 zeolites and magnesium lithium oxide catalysts, and the effect of steam^[10].

Heinz Heinemann left with us a tradition of curiosity, the interest in technology and energy conversion, close scrutiny of experimental data and carrying out seminal studies of kinetics and catalyst structures to understand the fundamental ingredients of catalyst activity and selectivity. He had important influence on the next generation of researchers and he played a significant role in the history of catalysis science.

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Figure 1. Heinz Heinemann

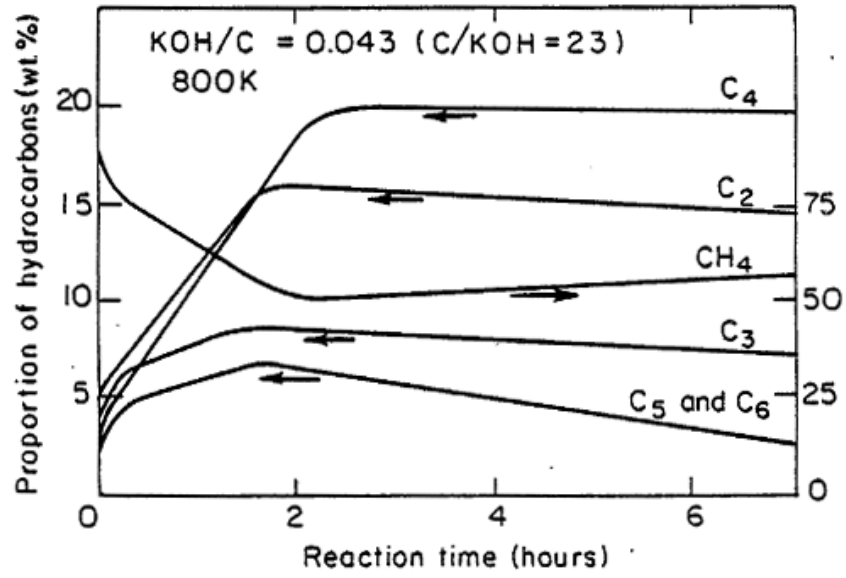


Figure 2 Plot of dependence on reaction time of the proportion of hydrocarbons for a KOH/C loading equal to 0.043 (mol).