

## FERMENTATIVE OXIDATION OF BUTANE IN BUBBLE COLUMN REACTORS

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**Key Words:** Oxidation, Butane, Bubble Column, Fermentation, Transport Limitation

To date the use of alkanes as starting materials for selective activation in chemical industry is very challenging. For this task the biocatalytic selective activation offers a number of advantages. The activation starts with C-H functionalization by a sequence of oxidation steps via alcohols, aldehydes/ ketones and carboxylic acids. All these derivatives are bulk-scale products, which are produced with standard chemical methods using high pressures and temperatures. In contrast, microorganisms are able to convert alkanes to various organic compounds at ambient pressure and temperature.[1] For the selective and efficient functionalization of alkanes appropriate fermentation of cells is required. Process engineering is required for a high yielding butane oxidation as well as reactor design. In this context it is essential to investigate the parameters of cell growth and to establish control of the fermentation conditions for production of the hydroxylated target compounds.

At first a suitable reactor set up in accordance to the safety regulations required for handling a flammable gas like butane had to be installed to enable reaction engineering studies of the cell and reactor system. Specialized bubble column reactors are developed on lab scale and characterized in view of the implementation at industrial scale.[2] Additionally, a suitable control system was designed to monitor as well as control standard parameters and to simplify the implementation of further equipment. The mass transfer of the gaseous starting materials into the fermentation media is the key limiting factor for reaching sufficient productivities. The process window is mainly restricted by the requirements of the microorganisms and the flammability region of the substrates.

Process parameters such as gassing rate or butane content are varied to characterize the system and provide understanding of the optimal stoichiometry and resulting volumetric productivities.



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[2] C. Pfeffer, T. Haas, O. Thum, F. Erhardt, E. M. Wittmann, C. Gehring, S. Hafkemeyer, T. Hueller, (2015) US patent 20150044744 A1

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*Figure 1: Experimental setup with stirred tank reactor and two 2 liter bubble column reactors for fermentative butane oxidation*