Controlling Properties of Sulfur Particles Formed in Biological Desulfurization

Aug 2016 - 2020

Researcher	Supervisors	Promotor
Annemerel Mol	Dr. Renata van der Weijden Dr. ir. Jan Klok	Prof. dr. ir. Cees Buisman

Motivation

Biogas, natural gas and other fuel gasses may contain corrosive components such as H_2S which has detrimental effects on the environment when combusted. Consequently, it is required to remove H_2S from gas before it can be used. Hence, a biotechnological desulfurization process was developed at Wageningen University, which uses natron-alkaline sulfide oxidizing bacteria (Fig. 1). This process is an alternative to chemo-physical processes which are commonly applied in industry. Advantages of the biological process are (i) no consumption of chelating chemicals, (ii) operation at atmospheric pressure and ambient temperature, (iii) high removal efficiency with a sulfide-free waste stream and (iv) beneficial use of the biologically produced sulfur.

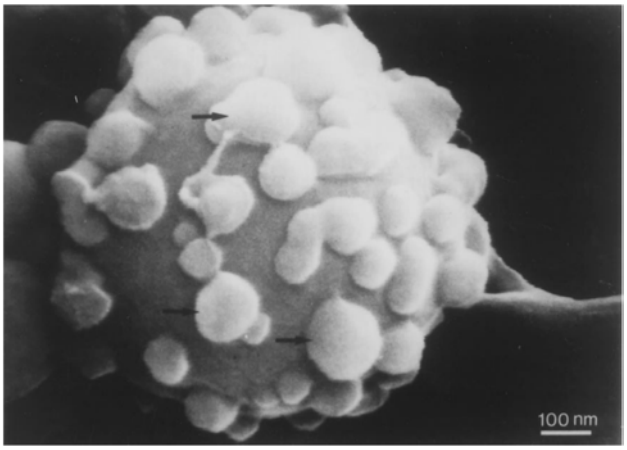

Figure 1 *Thiobacillus* excreting sulfur [Janssen, A. et al. (1996)]

Technological challenge

In the desulfurization process, H_2S is absorbed into a mild alkaline liquid and dissociated (Eq.1). Subsequently, the dissolved HS^- is oxidized to elemental sulfur in a bioreactor (Eq.2).

$$H_2S\ (l) + CO_3^{2-} \rightleftarrows HS^- + HCO_3^- \quad (1)$$

$$HS^- + \tfrac{1}{2}O_2 \rightarrow \tfrac{1}{8}S_8^0 + OH^- \quad (2)$$

In addition to elemental sulfur, other sulfur compounds are formed as by-product, like sulfuric acid (Eq.3).

$$HS^- + 2O_2 \rightarrow SO4^{2-} + H^+ \quad (3)$$

While formation of elemental sulfur is proton-neutral, the formation of other S-products requires compensation of produced protons by addition of NaOH.

Although the optimization of sulfur formation has been studied extensively, specific properties of the formed sulfur, like filterability and settleability, remain subject of interest. Knowledge on how to control particle properties will lead to higher recovery of the biosulfur.

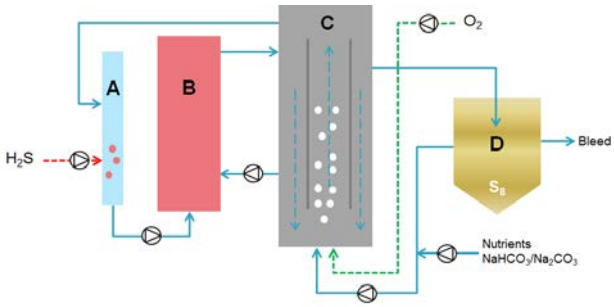

Figure 2 Novel reactor line-up

The optimization of sulfur formation and recovery is aimed for by operating a novel reactor line-up including an anoxic reactor B (Fig 2), which is compared to the classic Thiopaq line-up in terms of (1) sulfur particle properties, (2) microbial composition and (3) long term stability. Also the relation between these parameters is assessed.

CV Researcher;	Annemerel Mol
Graduated;	Wageningen University, Biotechnology (2016)
Hobbies;	Volleyball, organizing music festivals
e-mail;	annemerel.mol@wur.nl
tel;	0317-483997
website;	www.paqell.com