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Harvesting of Dunaliella tertiolecta cells by magnetic filtration

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The rising cost and reduced reserves of fossil fuels have enhanced the interest for finding alterative energy sources. Microalgae are considered to be the only sustainable option in biodiesel production for two key points. The energy yield from microalgae is much higher than that of oil producing crops, and the cultivation of algae it is not antagonistic with food supply chain. Because of the small size of microalgae and the dilute nature of algal cultures, the harvesting cost of microalgae is so far a limiting step for the scale up of microalgal biofuel production. It is estimated that the algal harvesting cost is at least 20-30% of the total biomass production cost. Traditional methods, which have been employed for the recovery of microalgal biomass, include centrifugation, gravity separation, filtration, flocculation, and flotation. Alternative approaches, other than conventional methods, capable of processing large cultures volume at a low cost, and reducing effluent toxicity are essential for microalgal biomass production. Magnetic separation is a promising technology and has been applied for algal removal in the mid of 1970s.

The aim of this study was to investigate the harvesting of microalgae cells using magnetic microparticles (MPs). Dunaliella tertiolecta was selected as a representative for marine microalgae. The cultivation of microalgae was conducted under continuous artificial light, in 20 L flasks. Iron oxide microparticles were prepared by microwave irradiation of FeSO4 $7H_2O$ in an alkaline solution. Samples were taken at different operation intervals to conduct harvesting studies. Batch and flow-through experiments were conducted in order to investigate the effect of the magnetic material on microalgae removal. Algal removal in flow through experiments ranged from 70 to 85% depending on the initial MPs concentration even at very short hydraulic retention times (i.e. 2 min). In batch tests, algal removal was up to 97% at MPs concentration of 490 mg/L.