

## Comparative study of three types of microbial fuel cell

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### Abstract

Three different generations (Gen-I, -II and -III) of microbial fuel cell (MFC), distinguished by their historical development and mechanisms of electron transfer, were compared. Gen-I utilised synthetic redox mediators combined with *Escherichia coli*. In contrast, the Gen-II exemplar utilised the natural mediating properties of sulphate/sulphide with the sulphate reducing species *Desulfovibrio desulfuricans*. Gen-III MFCs were based on the anodophilic species *Geobacter sulfurreducens* and required no soluble mediator. Each type of MFC was operated under similar environmental conditions. In terms of substrate to power conversion efficiency, Gen-II was most efficient (64.52%), followed by Gen-III (47.38%) and Gen-I (28.12%). When output was expressed as power/unit of cells, Gen-III was 28-fold higher by comparison ( $33.72 \times 10^{15}$  e/ $\mu\text{g}$  cells). For comparative purposes, these results were produced using equal rather than optimal circuit loads. Under optimal loading conditions, Gen-III produced on average five-fold higher power than under equal load and the conversion efficiency was 95%. To the best of the authors' knowledge, this is the first time that these three types of MFC have been experimentally compared under similar conditions. Gen-II and -III but not Gen-I may be used advantageously in wastewater treatment and power generation from organic matter.

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