Performance Control and Optimization of KO2 -Ca(OH)2 Based Oxygen Generator to Enhance Survival Rates in Emergency and Disaster Environments

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This study optimizes the composition and factors of potassium superoxide (KO2) and calcium hydroxide (Ca(OH)2) for use in a chemical oxygen generator (COG) for emergency escape devices. The study's proposed COG produces oxygen only relying on exhaled carbon dioxide and water vapor. KO2 produces oxygen through reaction with exhaled moisture (H2O) while Ca(OH)2 functions as a carbon dioxide absorbent. In addition, CO2 absorption by Ca(OH)2 produces H2O as a byproduct which further supplements the KO2-H2O reaction increasing overall oxygen generation. To maximize oxygen production, a Design of Experiment (DoE) methodology was used through the MiniTab statistics program to evaluate multiple factors for main effects simultaneously (composition, particle size distribution, H2O-CO2 ratio, intermediate presence, KO2-Ca(OH)2) composition ratio). DoE results showed that for a 5 gram KO2-Ca(OH)2 sample, oxygen production was maximized using a PSD D50 3mm, 8:2 KO2-Ca(OH)2 ratio, 8:2 H2O-CO2 ratio, and intermediate material. The KO2-Ca(OH)2 ratio and intermediate material were the most statistically significant factors with main effects of -25.63 and +19.12. The model also demonstrated significant accuracy (R-Sq = 98.11%, predicted R-Sq = 80.69%, adjusted R-Sq = 94.34%). A validation experiment confirmed the optimized configurations could sustain an oxygen concentration of 18.4% for 5 minutes under typical human respiration parameters. These findings support the feasibility of a portable and handheld emergency escape COG based on the optimized KO2-Ca(OH)2 configurations.

Awards Won:

Second Award of $2,400