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Methanation of Carbon Dioxide over Ru/Mn/Ce-Al₂O₃ Catalyst: In-Depth of Surface Optimization, Regeneration and Reactor Scale

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ACCEPTED MANUSCRIPT

1 2 3	Methanation of Carbon Dioxide over Ru/Mn/Ce-Al ₂ O ₃ Catalyst: In-Depth of Surface Optimization, Regeneration and Reactor Scale
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15	
16	Abstract
17	Converting the CO ₂ gas via catalytic methanation technology has significant potential
18	application in the power plant industry. Therefore, ceria based catalyst impregnated with
19	$Ru/Mn/Al_2O_3$ was developed and from the experimental results, the optimum conditions over
20	potential Ru/Mn/Ce(5:30:65)/Al ₂ O ₃ catalyst was achieved with 65 wt% of Ce based loading
21	calcined at 1000°C gave 97.73% of CO_2 conversion with 91.31% of CH_4 at 200°C of reaction
22	temperature. 10 g of the potential catalyst was pre-reduced at 300°C for 30 minutes in the
23	presence of H ₂ gas prior to the start of catalytic testing. The reliability, robustness,
24	reproducibility and regeneration testing of this catalyst were further studied. The catalyst
25	started to deactivate (spent catalyst) at sixth testing with only gave 41.17% CO ₂ conversion.
26	However, the catalyst can be regenerated in the presence of compressed air at 400°C for 3 hours
27	as it gave 92.85% of CO_2 conversion. From the characterization of spent catalyst, the factor for
28	the catalyst deactivation in this reaction was the particle agglomeration due to the loss of RuO_2
29	and Mn ₂ O ₃ species. When the catalyst was scale-up, the result showed that
30	$Ru/Mn/Ce(5:30:65)/Al_2O_3$ catalyst able to convert 60% of CO_2 and 50.4% of methane
31	formation at lower reaction temperature of 160°C.
32	
33	Keywords: methanation, scale-up, flue gases, carbon dioxide, catalyst, ceria
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