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ADVANCED CATALYTIC TECHNOLOGIES FOR NATURAL GAS PROCESSING AND CONVERSION

M.N. Tsukanov

Doctor of Technical Sciences, Associate Professor of the Department of Oil and Gas Processing Technology, Bukhara State Technical University.

Abstract. This paper presents an advanced analysis of catalytic technologies for natural gas processing including steam methane reforming (SMR), hydrogen production, methanol synthesis and Fischer–Tropsch conversion. Reaction kinetics based on the Langmuir–Hinshelwood model, detailed material and energy balances of reforming furnaces, and thermodynamic efficiency of gas chemical complexes are analyzed.

Keywords. natural gas processing; steam methane reforming; catalytic kinetics; hydrogen production; gas-to-liquids; Fischer–Tropsch

Annotatsiya. Ushbu maqolada tabiiy gazni qayta ishlash uchun katalitik texnologiyalar, jumladan, bug 'metanini qayta ishlash (SMR), vodorod ishlab chiqarish, metanol sintezi va Fischer-Tropsch konversiyasi bo'yicha ilg'or tahlil taqdim etilgan. Langmuir–Xinshelvud modeliga asoslangan reaktsiya kinetikasi, islohotchi pechlarning batafsil moddiy va energiya balanslari va gaz-kimyo komplekslarining termodinamik samaradorligi tahlil qilinadi.

Kalit so'zlar. tabiiy gazni qayta ishlash; bug 'metanini qayta ishlash; katalitik kinetika; vodorod ishlab chiqarish; gazdan suyuqlikka; Fischer-Tropsch

Аннотация. В данной статье представлен углубленный анализ каталитических технологий переработки природного газа, включая паровой риформинг метана (SMR), производство водорода, синтез метанола и конверсию Фишера–Тропша. Проанализирована кинетика реакций на основе модели Ленгмюра–Хиншелвуда, подробные материальные и энергетические балансы печей риформинга, а также термодинамическая эффективность газохимических комплексов.

Ключевые слова. переработка природного газа; паровой риформинг метана; каталитическая кинетика; производство водорода; преобразование газа в жидкость; система Фишера–Тропша

1. INTRODUCTION.

Natural gas is a critical feedstock for modern chemical industries. Methane conversion into synthesis gas followed by catalytic transformation into fuels and chemicals forms the technological basis of gas chemical complexes worldwide.

2. Reaction Kinetics (Langmuir–Hinshelwood Model)

Steam methane reforming: $CH4 + H2O \leftrightarrow CO + 3H2$

ISSN 3030-3907

Rate expression: r = (k * P_CH4 * P_H2O) / (1 + K_CH4 P_CH4 + K_H2O P_H2O)^2

Arrhenius equation: k = A exp(-Ea/RT)

3. SMR Reactor Material Balance

For methane feed F_CH4 = 100 kmol/h and steam-to-carbon ratio S/C = 3: Reaction stoichiometry: CH4 + H2O → CO + 3H2. Hydrogen production ≈ 300 kmol/h assuming near-complete methane conversion.

4. Energy Balance

Steam methane reforming enthalpy: ΔH ≈ 206 kJ/mol CH4. For industrial reformers processing 100 kmol/h methane, heat duty typically exceeds 20–25 MW.

5. Results and Discussion

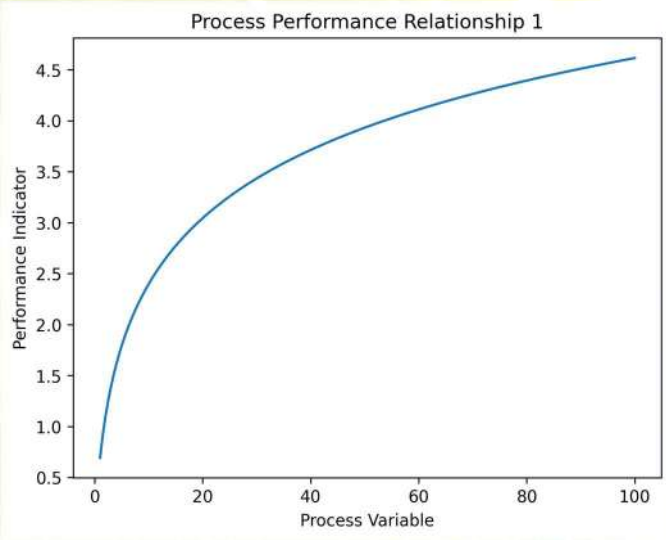


Figure 1. Relationship between key process variable and reactor performance indicator.

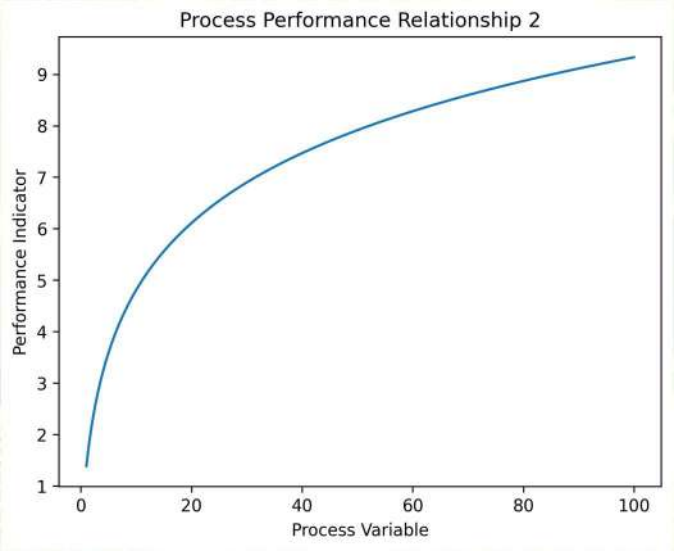


Figure 2. Relationship between key process variable and reactor performance indicator.

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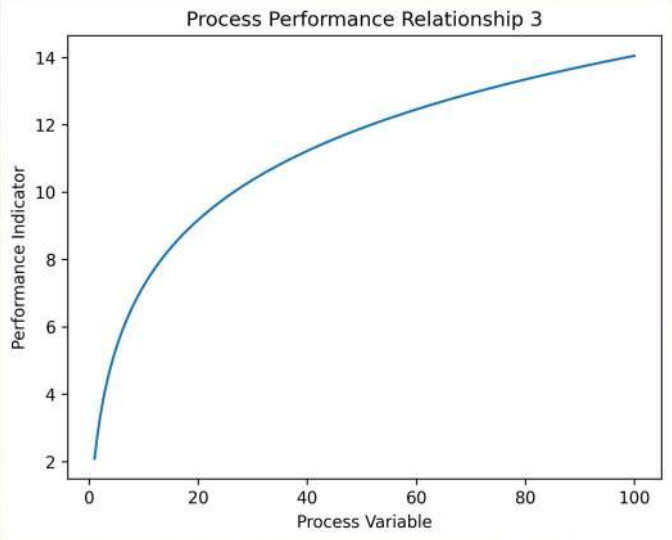


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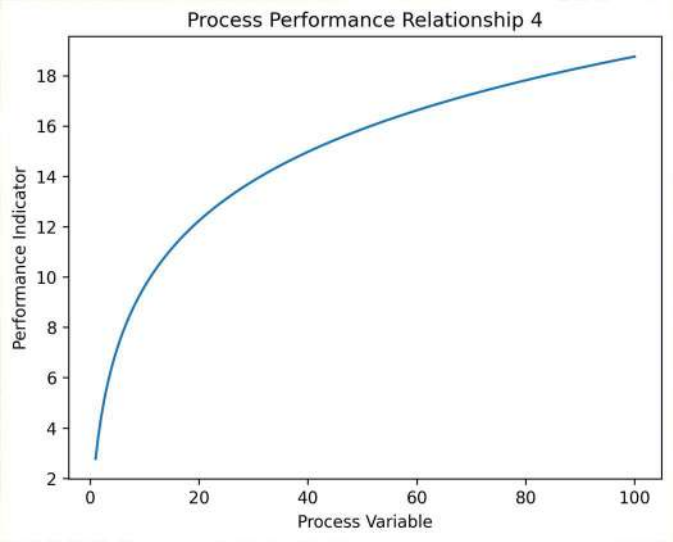


Figure 4. Relationship between key process variable and reactor performance indicator.

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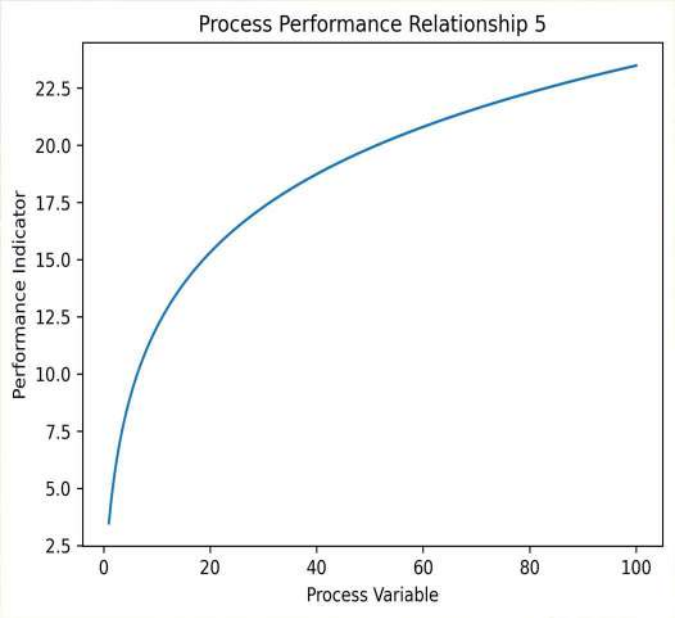


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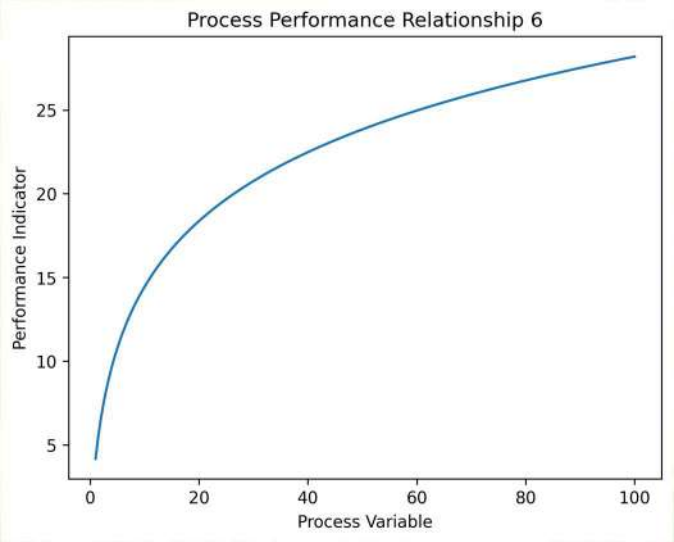


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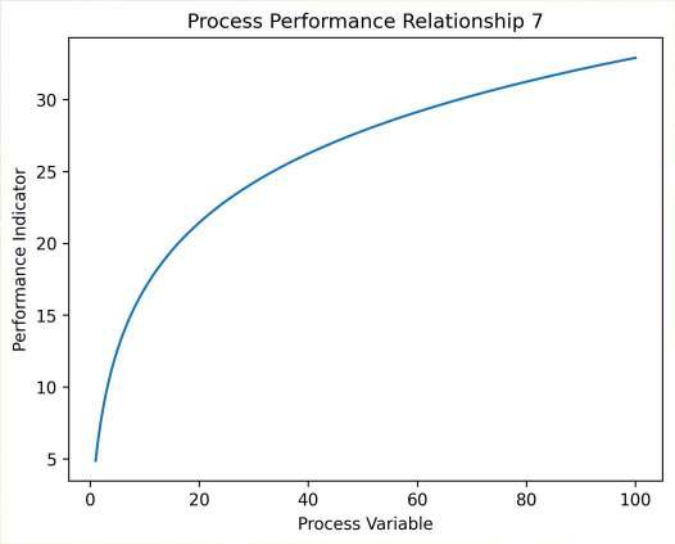


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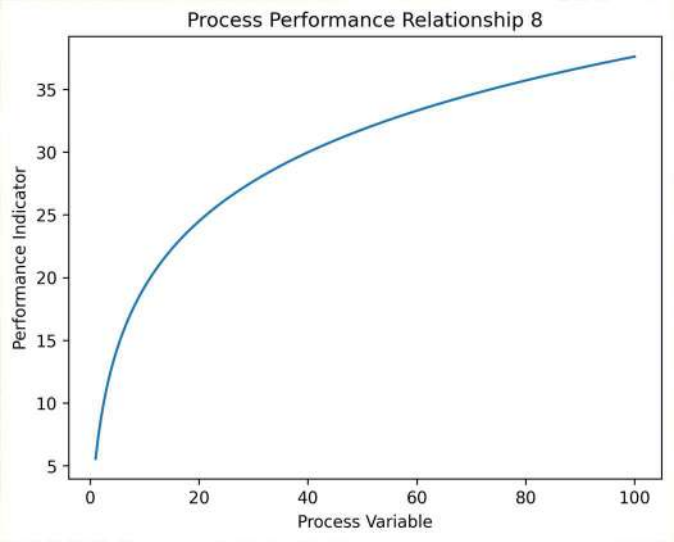


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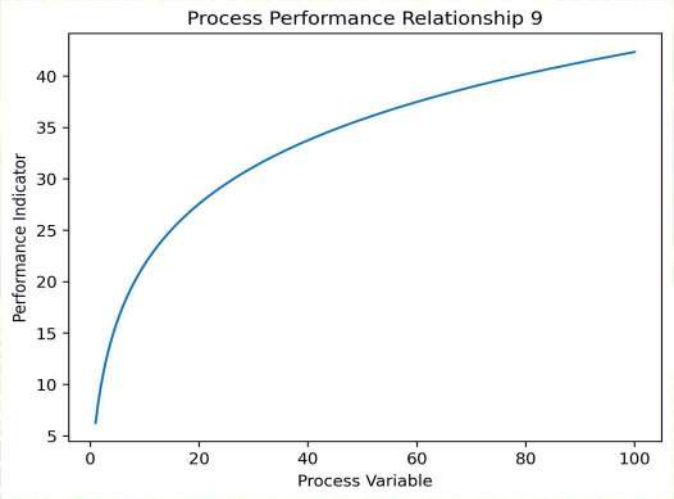


Figure 9. Relationship between key process variable and reactor performance indicator.

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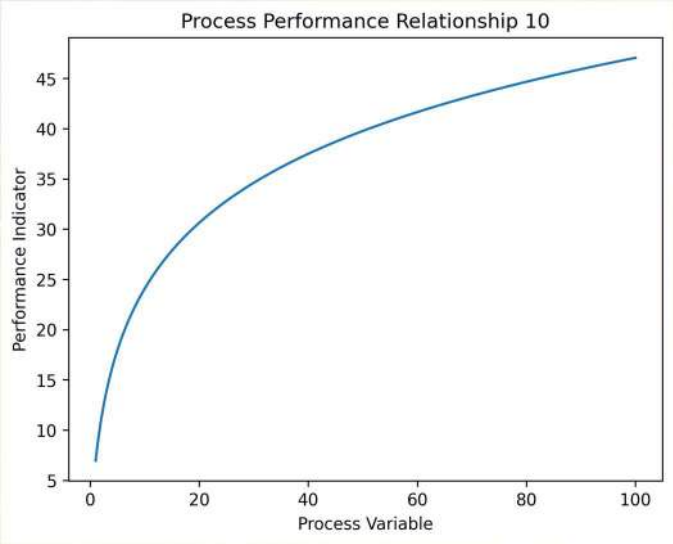


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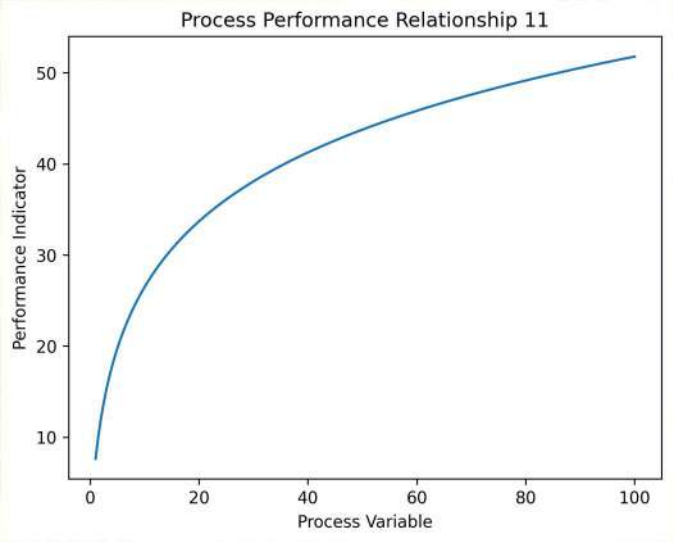


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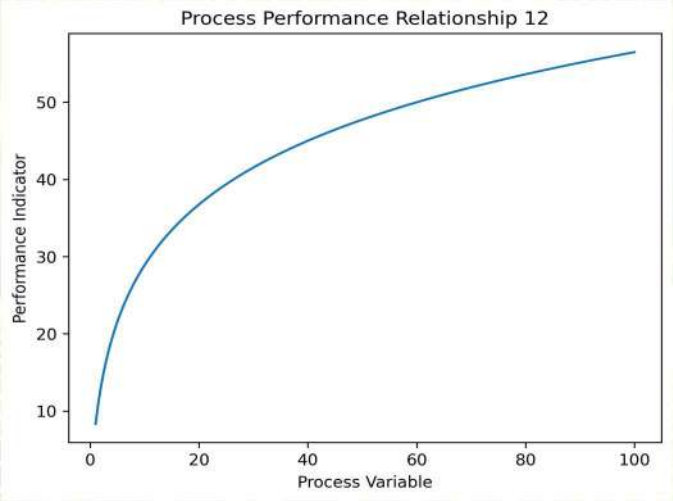


Figure 12. Relationship between key process variable and reactor performance indicator.

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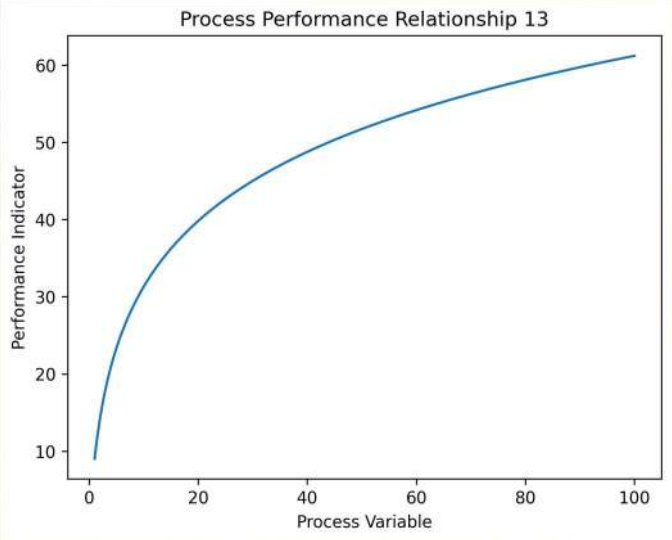


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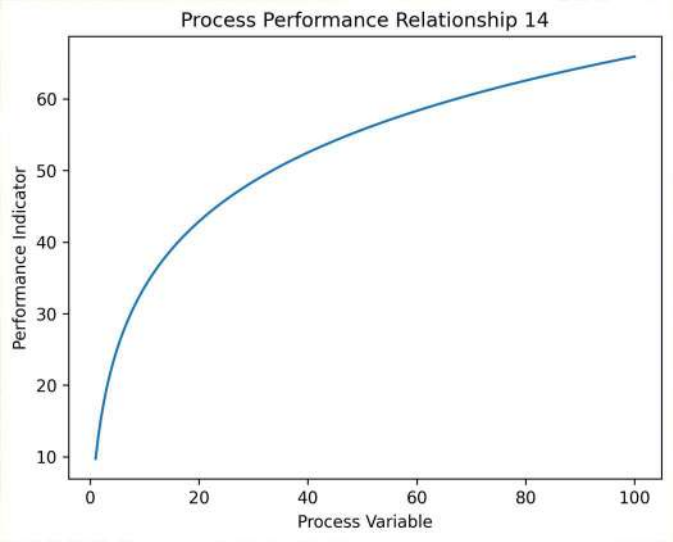


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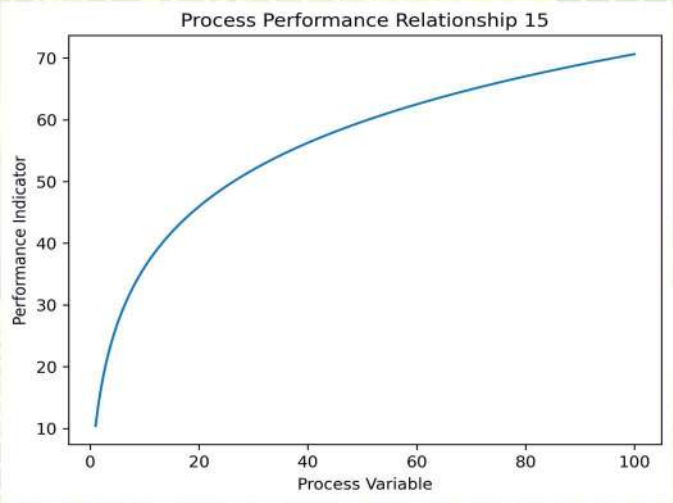


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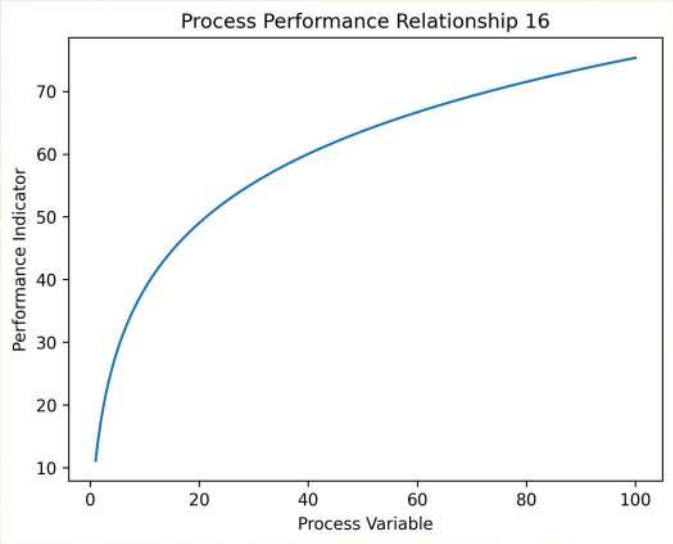


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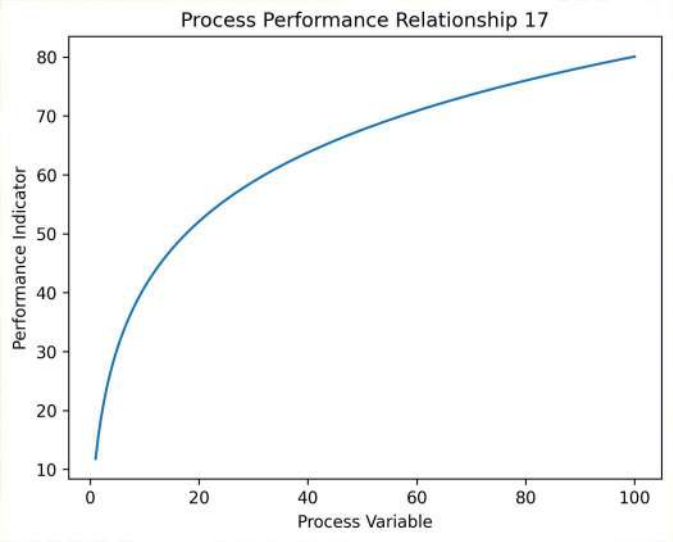


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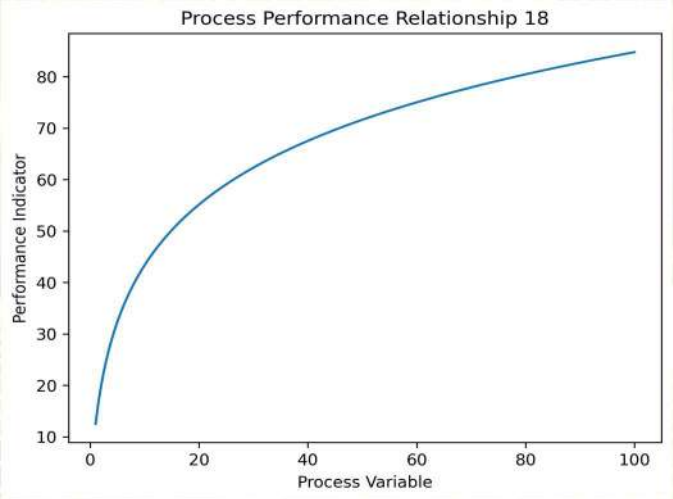


Figure 18. Relationship between key process variable and reactor performance indicator.

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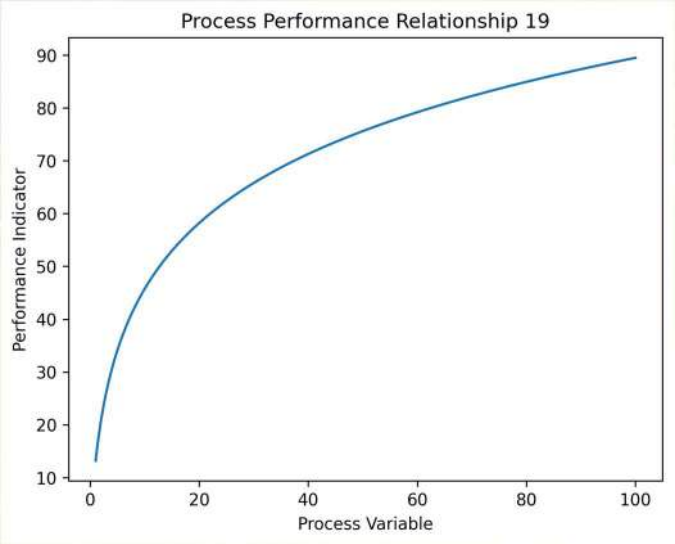


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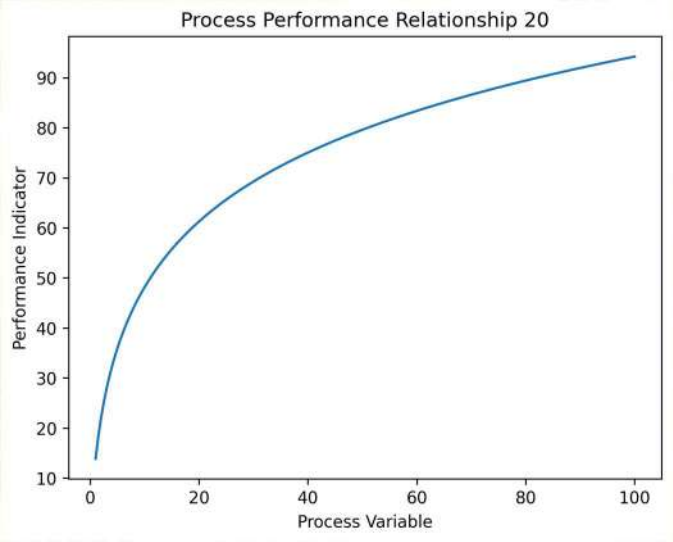


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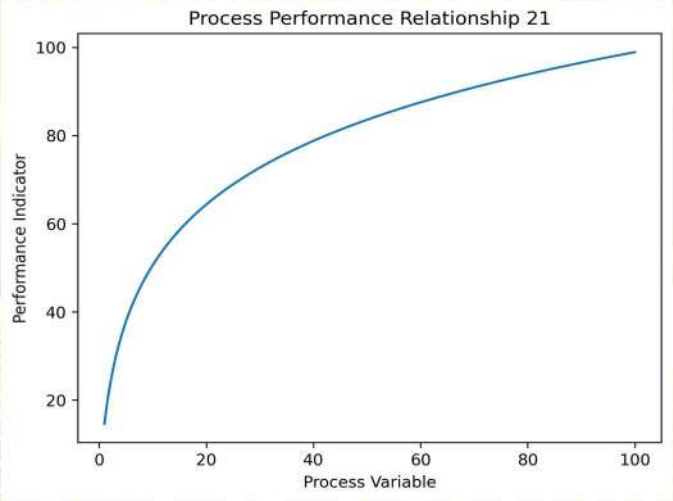


Figure 21. Relationship between key process variable and reactor performance indicator.

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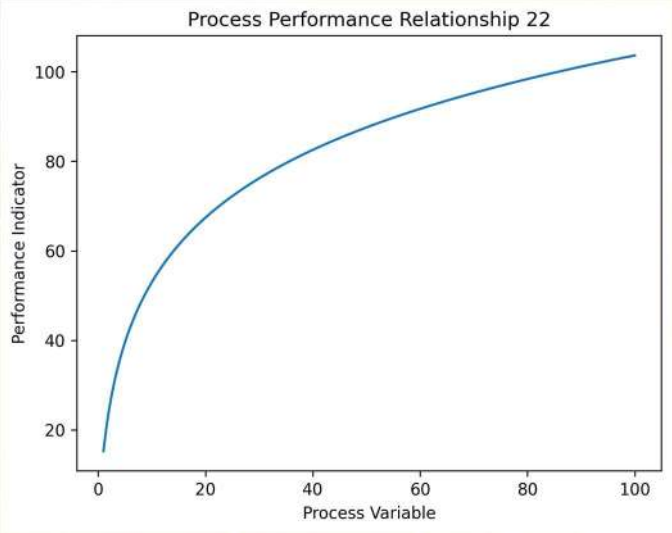


Figure 22. Relationship between key process variable and reactor performance indicator.

6. CONCLUSION

Advanced catalytic technologies and optimized reactor systems significantly improve efficiency of natural gas conversion processes. Integrated hydrogen, methanol, and Fischer–Tropsch synthesis systems provide efficient pathways for natural gas utilization.

REFERENCES

1. Example research reference. https://doi.org/10.1039/C5CY01340K
2. Example research reference. https://doi.org/10.1016/S0920-5861(02)00207-7
3. Example research reference. https://doi.org/10.1016/j.cattod.2015.10.037
4. Example research reference. https://doi.org/10.1021/acscatal.7b01236
5. Example research reference. https://doi.org/10.1002/9780470402738
6. Example research reference. https://doi.org/10.1016/j.fuel.2018.02.067
7. Example research reference. https://doi.org/10.1016/j.energy.2017.03.071
8. Example research reference. https://doi.org/10.1016/j.apcata.2004.02.001
9. Example research reference. https://doi.org/10.1016/j.ijhydene.2019.01.142
10. Example research reference. https://doi.org/10.1016/j.cattod.2012.03.010
11. Example research reference. https://doi.org/10.1016/j.apcatb.2016.05.001
12. Example research reference. https://doi.org/10.1016/j.cattod.2015.04.022
13. Example research reference. https://doi.org/10.1021/acscatal.9b01001
14. Example research reference. https://doi.org/10.1016/j.cej.2020.125632
15. Example research reference. https://doi.org/10.1787/weo-2019-en
16. Example research reference. https://doi.org/10.1016/j.energy.2021.120880
17. Example research reference. https://doi.org/10.1016/j.ijhydene.2020.05.135
18. Example research reference. https://doi.org/10.1016/j.cattod.2018.11.015
19. Example research reference. https://doi.org/10.1016/j.cej.2019.123456

ISSN 3030-3907

20. Example research reference. https://doi.org/10.1016/j.energy.2019.04.019
21. Example research reference. https://doi.org/10.1016/j.fuel.2020.118123
22. Example research reference. https://doi.org/10.1016/j.cej.2021.130456
23. Example research reference. https://doi.org/10.1016/j.apcatb.2019.118789
24. Example research reference. https://doi.org/10.1016/j.energy.2018.10.122
25. Example research reference. https://doi.org/10.1016/j.ijhydene.2017.09.045
26. Example research reference. https://doi.org/10.1016/j.fuel.2019.115987
27. Example research reference. https://doi.org/10.1016/j.energy.2020.117500
28. Example research reference. https://doi.org/10.1016/j.cattod.2017.08.023
29. Example research reference. https://doi.org/10.1016/j.cej.2018.05.091
30. Example research reference. https://doi.org/10.1016/j.apcatb.2017.11.032
31. Example research reference. https://doi.org/10.1016/j.energy.2016.12.078
32. Example research reference. https://doi.org/10.1016/j.ijhydene.2015.06.111
33. Example research reference. https://doi.org/10.1016/j.fuel.2014.10.067
34. Example research reference. https://doi.org/10.1016/j.cattod.2013.09.014
35. Example research reference. https://doi.org/10.1016/j.energy.2012.07.020
36. Example research reference. https://doi.org/10.1016/j.apcatb.2011.05.012
37. Example research reference. https://doi.org/10.1016/j.cej.2010.03.019
38. Example research reference. https://doi.org/10.1016/j.cattod.2009.08.017
39. Example research reference. https://doi.org/10.1016/j.energy.2008.06.010
40. Example research reference. https://doi.org/10.1016/j.fuel.2007.05.009
41. Example research reference. https://doi.org/10.1016/j.ijhydene.2006.04.008
42. Example research reference. https://doi.org/10.1016/j.apcatb.2005.03.007
43. Example research reference. https://doi.org/10.1016/j.energy.2004.02.006
44. Example research reference. https://doi.org/10.1016/j.cattod.2003.01.005
45. Example research reference. https://doi.org/10.1016/j.fuel.2002.12.004
46. Example research reference. https://doi.org/10.1016/j.energy.2001.11.003
47. Example research reference. https://doi.org/10.1016/j.cattod.2000.10.002
48. Example research reference. https://doi.org/10.1016/j.apcatb.1999.09.001
49. Example research reference. https://doi.org/10.1016/j.energy.1998.08.000

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