

**Pengaruh Komposisi Ligan *Tetrakis-(4-Carboxyphenyl)-Porphyrin* (TCPP) dan Pemurnian Pada Karakter Fisiko-kimia *Zeolitic Imidazolate Framework-8* (ZIF-8)**

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Diajukan Untuk Memenuhi Sebagian Dari Persyaratan Memperoleh Gelar Sarjana Sains  
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### **Pengaruh Komposisi Ligan *Tetrakis-(4-Carboxyphenyl)-Porphyrin* (TCPP) dan Pemurnian Pada Karakter Fisiko-kimia *Zeolitic Imidazolate Framework-8* (ZIF-8)**

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**PENGARUH KOMPOSISI LIGAN TETRAKIS-(4-CARBOXYPHENYL)-PORPHYRIN (TCPP) DAN PEMURNIAN PADA KARAKTER FISIKO-KIMIA ZEOLITIC IMIDAZOLATE FRAMEWORK-8 (ZIF-8)**

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# Pengaruh Komposisi Ligan *Tetrakis-(4-Carboxyphenyl)-Porphyrin* (TCPP) dan Pemurnian Pada Karakter Fisiko-kimia *Zeolitic Imidazolate Framework-8* (ZIF-8)

## Abstrak

Modifikasi ligan telah terbukti dapat merubah susunan struktur dari *Zeolitic Imidazolate Frameworks-8* (ZIF-8) melalui modifikasi terhadap komposisi kimia, ukuran pori, nano, dan cacat interkristalin/intrakristalin. Penelitian ini bertujuan untuk mengetahui pengaruh komposisi ligan *tetrakis-(4-carboxyphenyl)-porphyrin* (TCPP) serta pemurnian lanjutan pada sifat fisiko-kimia dari ZIF-8. Pengaruh komposisi dilakukan pada pemurnian oleh pencucian etanol dan pengeringan biasa. Untuk proses pemurnian kedua dilakukan dengan lagi melanjutkan pencucian oleh metanol dan *vacuum drying* (\*). Penelitian diawali dengan mensintesis prekursor ZIF-8 dengan komposisi Zn terhadap 2-Metilimidazol (2-MeIM) sebesar 1:8. Pada ZIF-8 termodifikasi TCCP disintesis pada komposisi Zn : 2-MeIM : TCCP pada 1:7,9:0,1; 1:7,5:0,5; dan 1:7:1. Sifat fisiko-kimia diamati oleh Difraksi Sinar-X (XRD), *Brunauer-Emmett-Teller* (BET), *Fourier Transform Infra Red* (FTIR), dan Analisis Termogravimetri/Termal Diferensial (TG/DTA). Pengaruh komposisi ditunjukkan dengan hasil XRD ZIF-8 dan ZIF-8-TCPP-1:7,9:0,1 memiliki struktur psedokristalin dan menjadi lebih amorf pada ZIF-8-TCPP-1:7,5:0,5 dan ZIF-8-TCPP-1:7:1. Data ini mengindikasikan adanya perubahan tatanan kerangka asli dari ZIF-8. Hal ini didukung oleh hasil FTIR dimana intensitas vibrasi Zn-N pada ZIF-8 berkurang seiring penambahan TCPP. Hasil BET menunjukkan bahwa ZIF-8-TCPP-1:7,9:0,1 memiliki luas permukaan yang jauh lebih besar dibanding prekursor ZIF-8 yaitu berturut-turut 189.878 m<sup>2</sup>/gram dan 41.372 m<sup>2</sup>/gram. Hasil TG/DTA teramati secara termal ZIF-8-TCPP-1:7,9:0,1 jauh lebih stabil dibanding ZIF-8. Hal ini terlihat dari persentase pengurangan massa 19,23% dan 1,83%. Sedangkan dari pengaruh pencucian didapatkan ZIF-8\* dan ZIF-8-TCPP-1:7,9:0,1\* pada pengujian XRD dan FTIR tidak menunjukkan perubahan yang signifikan. Untuk hasil BET teramati mengalami penurunan dan TG/DTA mengalami kenaikan kestabilan termal. Dari keseluruhan data tersebut dapat disimpulkan bahwa penambahan TCPP pada komposisi sampel ZIF-8-TCPP-1:7,9:0,1 memberikan peningkatan dari sisi struktur, luas permukaan dan kestabilan termal. Sedangkan pengaruh pencucian didapat tidak terlalu teramati memberi pengaruh pada struktur namun memberi penurunan pada luas permukaan dan peningkatan kestabilan secara termal.

**Kata Kunci:** ZIF-8, ZIF-8 termodifikasi Porfirin, Metode Pemurnian, *Metal Organic Framework*.

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# **The Effect of Tetrakis-(4-Carboxyphenyl)-Porphyrin (TCPP) Ligand Composition and Purification on the Physico-chemical Character of the Zeolytic Imidazolate Framework-8 (ZIF-8)**

## **Abstract**

Ligand modification has been shown to alter the structural arrangement of Zeolytic Imidazolate Frameworks-8 (ZIF-8) through modification of chemical composition, pore size, nanoscale, and intercrystalline/intracrystalline defects. This study aimed to determine the effect of the composition of the tetrakis-(4-carboxyphenyl)-porphyrin (TCPP) ligand and further purification on the physico-chemical properties of ZIF-8. The effect of composition carried out on purification by ethanol washing and ordinary drying, whereas the second washing process was carried out by again continuing the washing by methanol and vacuum drying (\*). The research began with the synthesis of ZIF-8 precursor with a Zn to 2-Methylimidazole (2-MeIM) ratio of 1:8. Meanwhile, TCCP-modified ZIF-8 was synthesized at the composition of Zn : 2-MeIM : TCCP at 1:7,9:0,1; 1:7,5:0,5; and 1:7:1. The physico-chemical properties were observed by X-Ray Diffraction (XRD), Brunauer–Emmett–Teller (BET), *Fourier Transform Infra Red* (FTIR), and Thermogravimetric/Differential Thermal Analysis (TG/DTA). Effect of composition indicated by XRD results ZIF-8 and ZIF-8-TCPP-1:7,9:0,1 have a pseudocrystalline structure and become more amorphous at ZIF-8-TCPP-1:7,5:0,5 and ZIF-8-TCPP-1:7:1. This data indicates a change in the original framework structure of ZIF-8. This is supported by the FTIR results where the Zn-N vibration intensity on ZIF-8 decreases with the addition of TCCP. According to the BET results, ZIF-8-TCPP-1:7,9:0,1 has a much larger surface area than ZIF-8 precursor, with 189,878 m<sup>2</sup>/gram and 41,372 m<sup>2</sup>/gram, respectively. Thermally observed TG/DTA results show ZIF-8-TCPP-1:7,9:0,1 is much more stable than ZIF-8. This can be seen from the percentage reduction in mass, which is 19.23% and 1.83%. From the influence of washing it was found that ZIF-8\* and ZIF-8-TCPP-1:7,9:0,1\* on XRD and FTIR tests did not show significant changes. Meanwhile, it was observed that the BET results decreased and TG/DTA experienced an increase in thermal stability. From all this data, it can be concluded that the addition of TCCP to the sample composition ZIF-8-TCPP-1:7,9:0,1 gave an increase in terms of structure, surface area, and thermal stability. While the influence of washing obtained was not observed to have an effect on the structure, it did give a decrease in the surface area and an increase in thermal stability.

**Keywords:** ZIF-8, Porphyrin-modified ZIF-8, Washing Method, Metal Organic Framework.

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