**ELECTRONIC SUPPLEMENTARY INFORMATION**

**A systematic literature review on the effects of synthesis conditions to the physicochemical properties of activated carbons and their performance in methylene blue adsorption**

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Table S1(a): Extracted Data (Synthesis Conditions) for Coconut Shell ACs

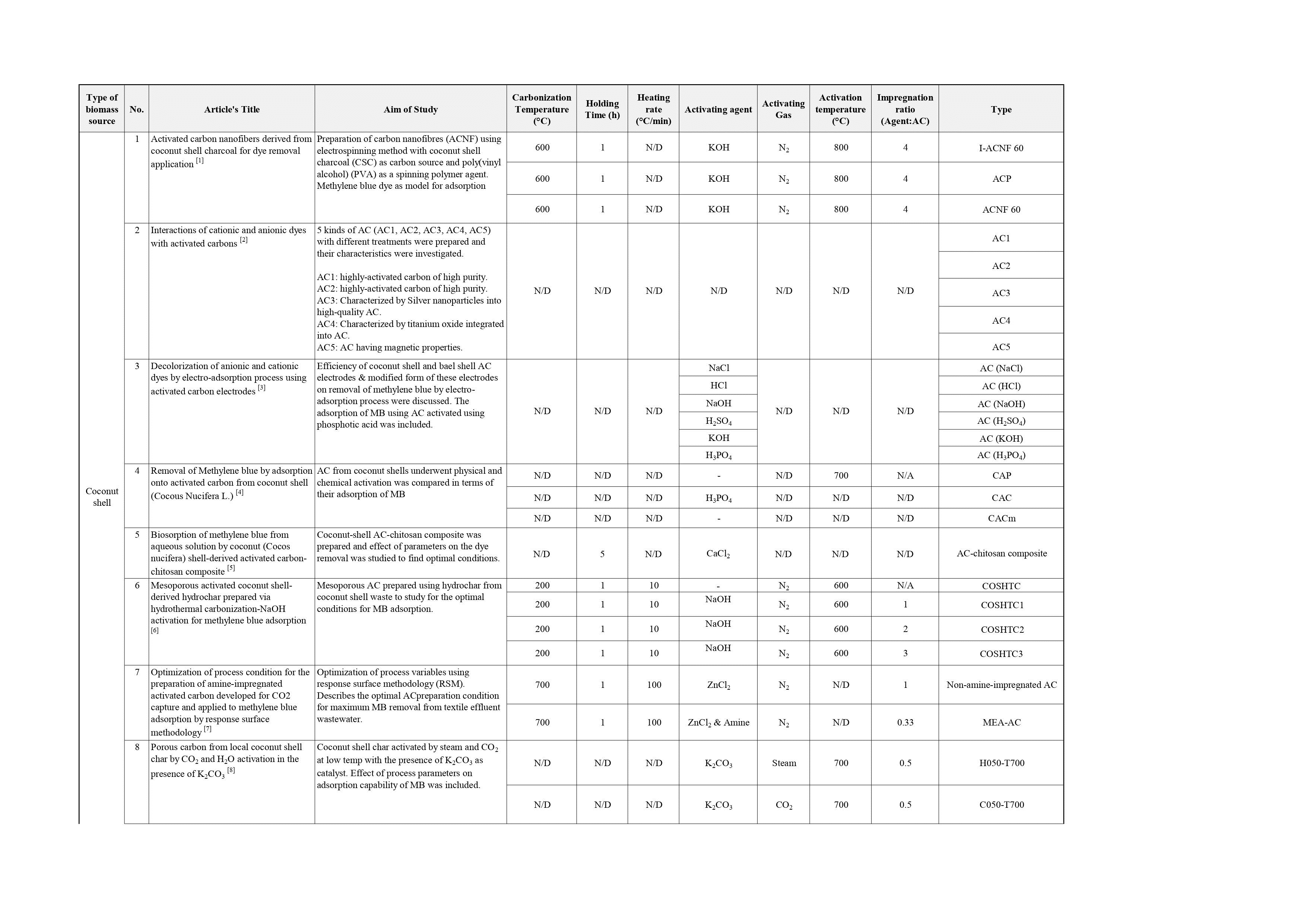
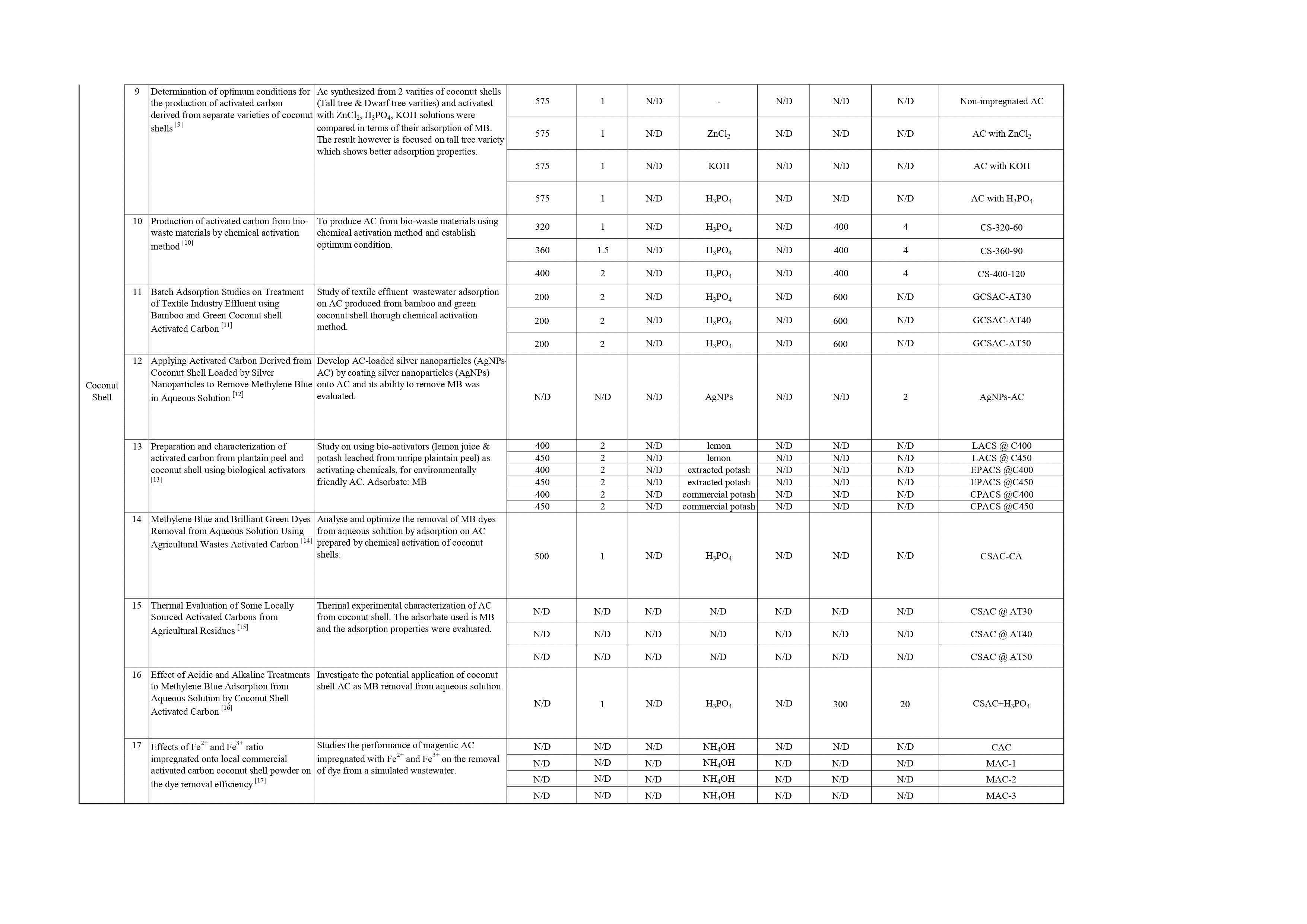


Table S1(a): Extracted Data (Synthesis Conditions) for Coconut Shell ACs (cont.)

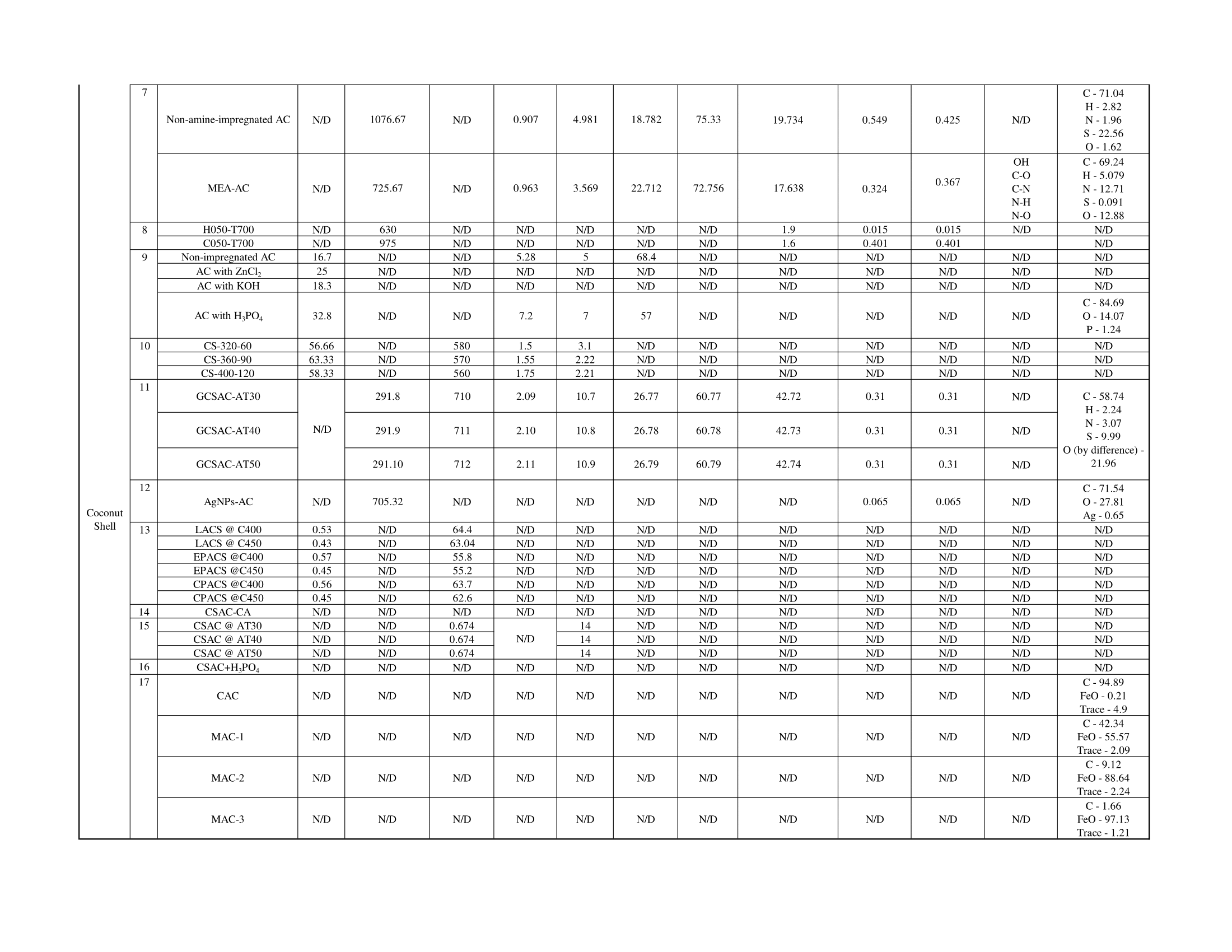


## Table S1(b): Extracted Data (Physicochemical Properties) for Coconut Shell ACs

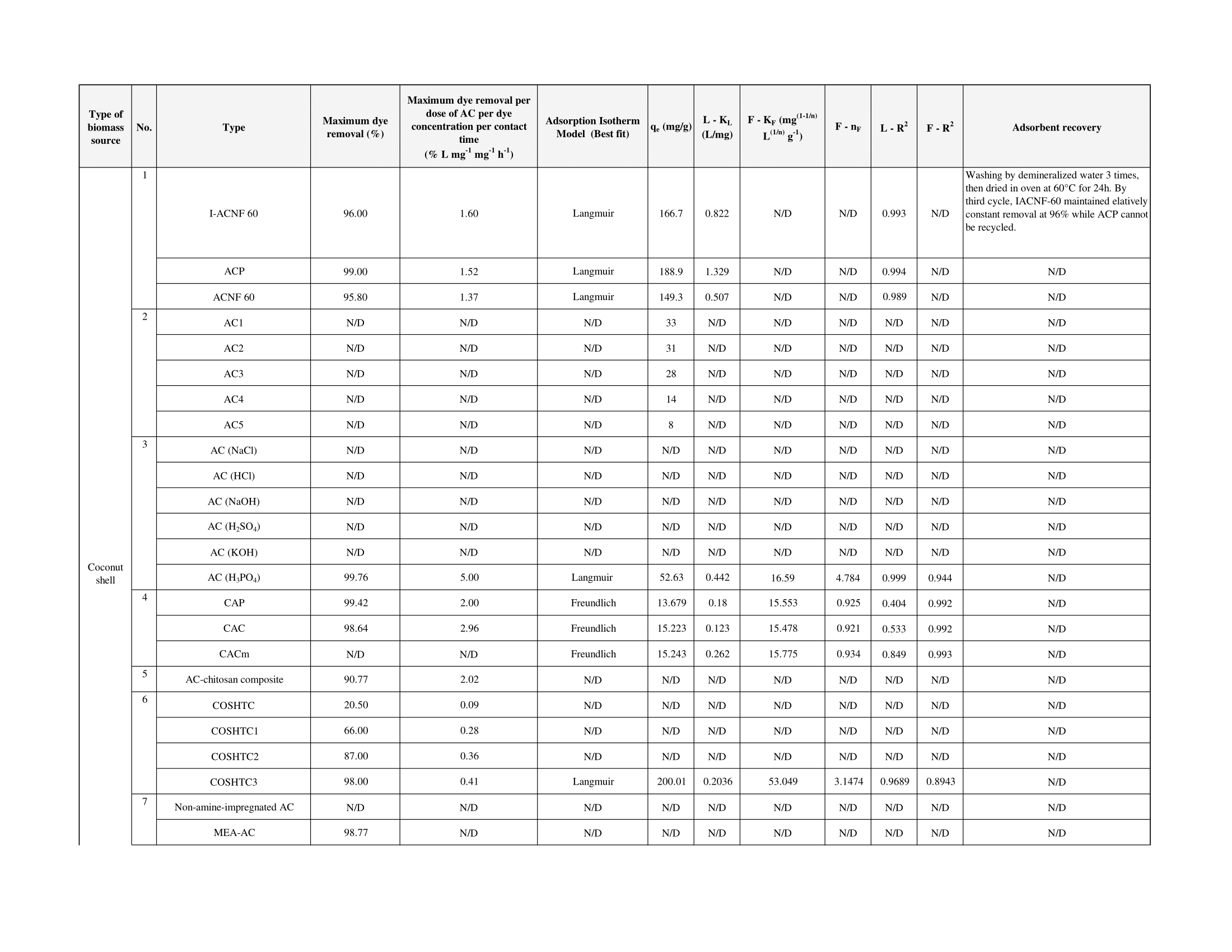
Table

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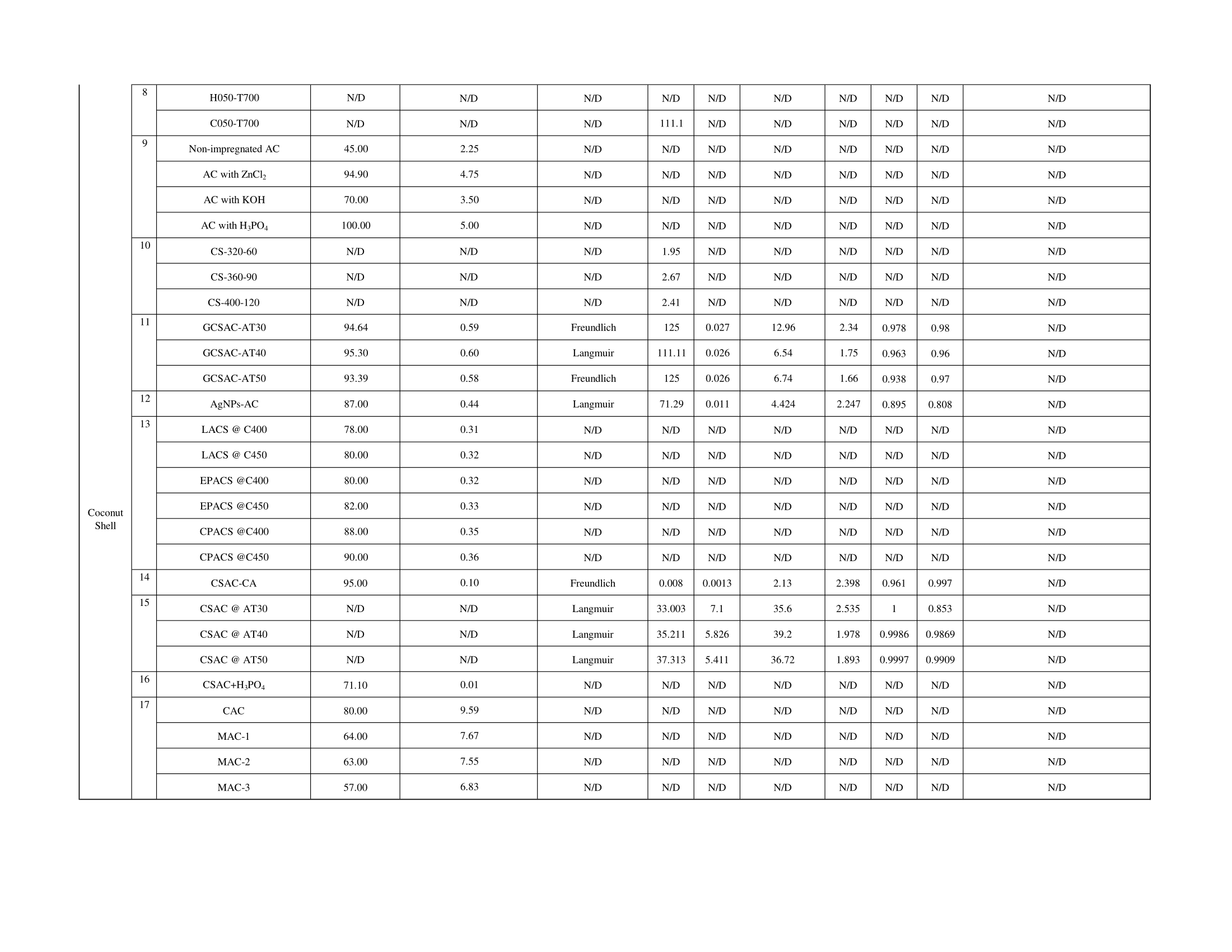
Table S1(b): Extracted Data (Physicochemical Properties) for Coconut Shell ACs (cont.)



## Table S1(c): Extracted Data (Adsorption Performance) for Coconut Shell ACs



## Table S1(c): Extracted Data (Adsorption Performance) for Coconut Shell ACs (cont.)



## Table S1(d): Extracted Data (Adsorption Conditions) for Coconut Shell ACs

Table

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## Table S1(d): Extracted Data (Adsorption Conditions) for Coconut Shell ACs (cont.)

Diagram

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Table S2(a): Extracted Data (Synthesis Conditions) for Bamboo ACs

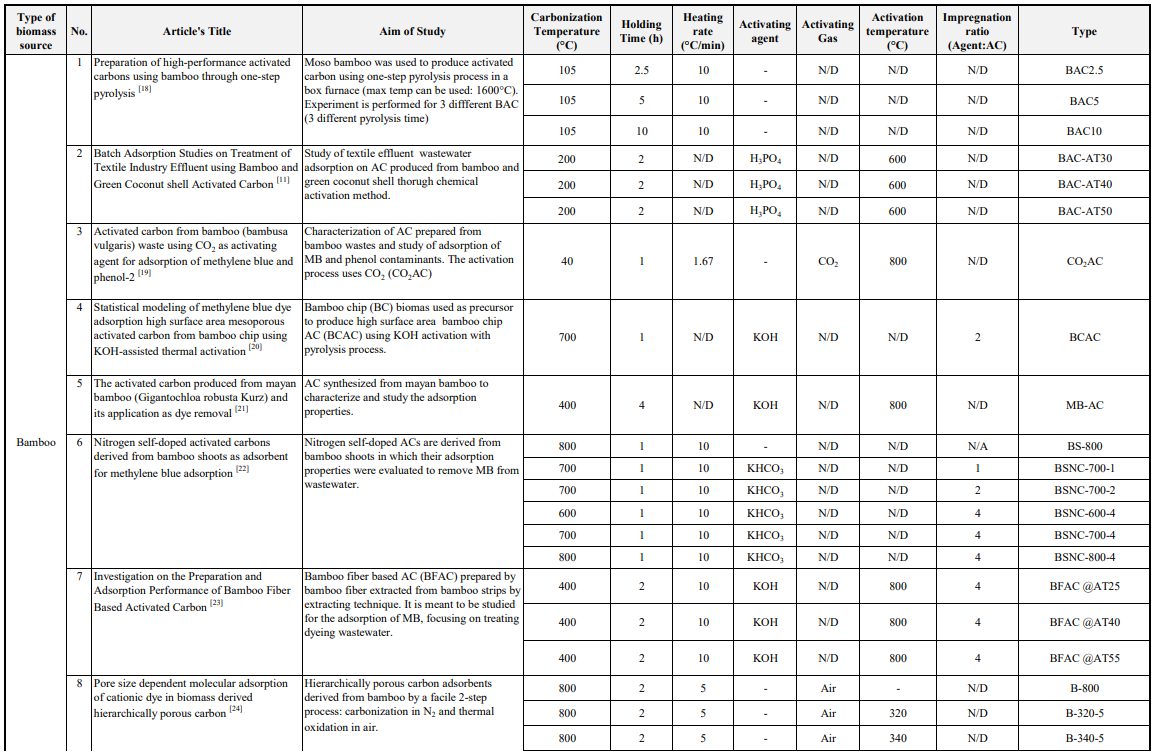


Table S2(a): Extracted Data (Synthesis Conditions) for Bamboo ACs (cont.)

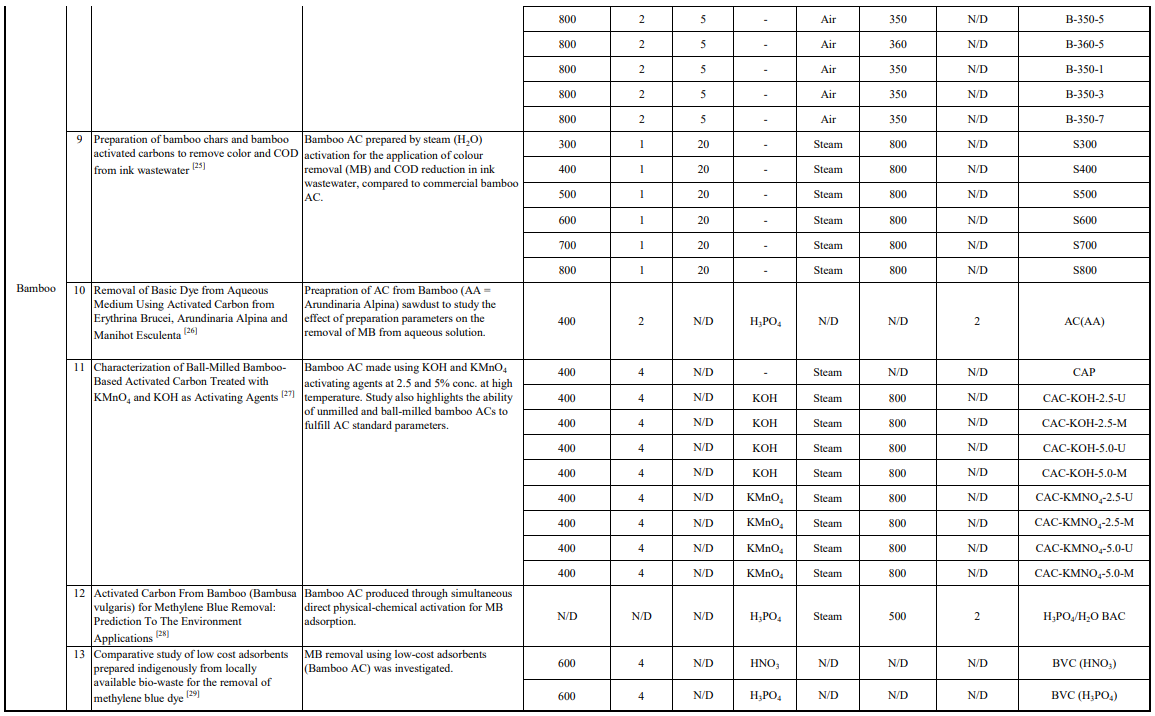


Table S2(b): Extracted Data (Physicochemical Properties) for Bamboo ACs

Table

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Table S2(b): Extracted Data (Physicochemical Properties) for Bamboo ACs (cont.)

Table

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Table S2(c): Extracted Data (Adsorption Performance) for Bamboo ACs

Table

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Table S2(c): Extracted Data (Adsorption Performance) for Bamboo ACs (cont.)

Table

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Table S2(d): Extracted Data (Adsorption Conditions) for Bamboo ACs

Diagram, schematic

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Table S2(d): Extracted Data (Adsorption Conditions) for Bamboo ACs (cont.)

Diagram, schematic

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Table S3(a): Extracted Data (Synthesis Conditions) for Rice Husk ACs

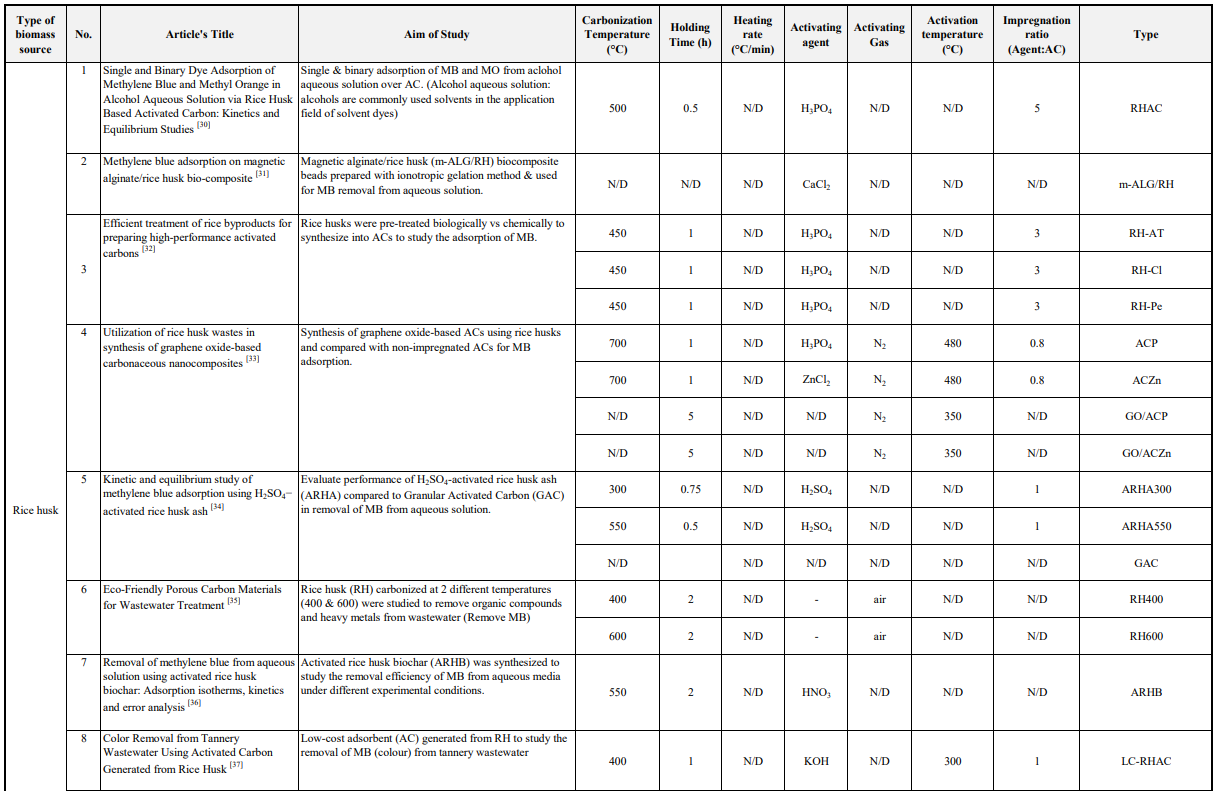


Table S3(a): Extracted Data (Synthesis Conditions) for Rice Husk ACs (cont.)

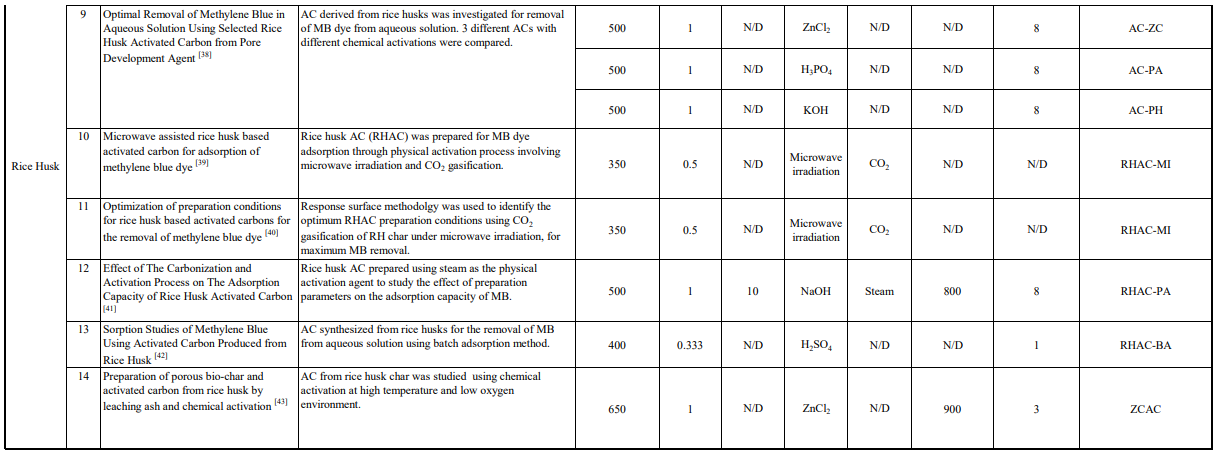


Table S3(b): Extracted Data (Physicochemical Properties) for Rice Husk ACs

Table

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Table S3(b): Extracted Data (Physicochemical Properties) for Rice Husk ACs (cont.)

Table

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Table S3(c): Extracted Data (Adsorption Performance) for Rice Husk ACs

Table

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Table S3(c): Extracted Data (Adsorption Conditions) for Rice Husk ACs

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REFRENCES:

1. Widiyastuti, W., Fahrudin Rois, M., Suari, N. M. I. P., Setyawan, H., Activated carbon nanofibers derived from coconut shell charcoal for dye removal application. *Adv. Powder Technol.* **2020**, 31(8), 3267–3273.
2. Ogata, F., Yasuda, S., Saenjum, C., Nakamura, T., Kawasaki, N., Interactions of cationic and anionic dyes with activated carbons. *E-J. Surf. Sci. and Nanotechnol*. **2020**, 18, 269–274.
3. Nainamalai, M., Palani, M., Allwin Ebinesar, J. S. S., Bhuvaneshwari, S., Decolorization of anionic and cationic dyes by electro-adsorption process using activated carbon electrodes. *Indian J. Chem.* **2019**, 26(4), 300–311.
4. Khuluk, R. H., Rahmat, A., Buhani, B., Removal of methylene blue by adsorption onto activated carbon from coconut shell (*Cocous Nucifera L*.). *Indones. J. Sci. and Technol*. **2019**, 4(2), 229–240.
5. Regunton, P. C. V., Sumalapao, D. E. P., Villarante, N. R., Biosorption of methylene blue from aqueous solution by coconut (*Cocos nucifera*) shell-derived activated carbon-chitosan composite. *Orient. J. of Chem.* **2018**, 34(1), 115–124.
6. Islam, M. A., Ahmed, M. J., Khanday, W. A., Asif, M., Hameed, B. H., Mesoporous activated coconut shell-derived hydrochar prepared via hydrothermal carbonization-NaOH activation for methylene blue adsorption. *J. Environ. Manage.* **2017**, 203, 237–244.
7. Das, D., Meikap, B. C., Optimization of process condition for the preparation of amine-impregnated activated carbon developed for CO2 capture and applied to MB adsorption by response surface methodology. *J. Environ. Sci. Health A* **2017**, 52(12), 1164–1172.
8. Vi, N. N. T., Truyen, D. H., Trung, B. C., An, N. T., Van Dung, N., Long, N. Q., Porous carbon from local coconut shell char by CO2 and H2O activation in the presence of K2CO3. *AIP Conf. Proc*. **2017**, 1878.
9. Sanni, E. S., Emetere, M. E., Odigure, J. O., Efeovbokhan, V. E., Agboola, O., Sadiku, E. R., Determination of optimum conditions for the production of activated carbon derived from separate varieties of coconut shells. *Int. J. Chem. Eng.* **2017**. 2801359.
10. Yasin, J., & Pravinkumar, R., Production of activated carbon from bio-waste materials by chemical activation method. *AIP Conf. Proc.* **2020**, 2225.
11. Bokil, S. A., Topare, N. S., Khedkar, S. V., Batch Adsorption Studies on Treatment of Textile Industry Effluent using Bamboo and Green Coconut shell Activated Carbon. *IOP Conf. Ser.: Mater. Sci. Eng.* **2020**, 983, 012005.
12. Van, H. T., Nguyen, T. M. P., Thao, V. T., Vu, X. H., Nguyen, T. V., Nguyen, L. H., Applying Activated Carbon Derived from Coconut Shell Loaded by Silver Nanoparticles to Remove Methylene Blue in Aqueous Solution. *Water Air Soil Pollut.* **2018**, 229, 393.
13. Efeovbokhan, V. E., Alagbe, E. E., Odika, B., Babalola, R., Oladimeji, T. E., Abatan, O. G., Yusuf, E. O., Preparation and characterization of activated carbon from plantain peel and coconut shell using biological activators. *J. Phys. Conf. Ser.* **2019**, 1378, 032035.
14. Ali, A. F., Kovo, A. S., Adetunji, S. A. (2017). Methylene Blue and Brilliant Green Dyes Removal from Aqueous Solution Using Agricultural Wastes Activated Carbon. *J. Encapsulation Adsorp. Sci.* **2017**, 07(02), 95–107.
15. Sangotayo, E. O. (2018). Thermal Evaluation of Some Locally Produced Activated Carbon from Agricultural Residue. *J. Nat. Sci. Res.* **2018**, 8(18), 23–31.
16. Abdullah, N. H., Inu, I., Razab, M. K. A. A., Noor, A. M., Zaudin, N. A. C., Rasat, M. S. M., Amin, M. F. M., Abdullah, W. N. W., Shukri, N. M., Halim, A. Z. A., Effect of Acidic and Alkaline Treatments to Methylene Blue Adsorption from Aqueous Solution by Coconut Shell Activated Carbon. *Int. J. Current Res. Sci. Eng. Technol.* **2018**, 319–324
17. Machdar, I., Faradillasari, C., Khair, N. A., Asnawi, T. M., BC, A. Y., Yunardi, Y., Effects of Fe2+ and Fe3+ ratio impregnated onto local commercial activated carbon coconut shell powder on the dye removal efficiency. *Jurnal Litbang Industri* **2018***,* 8(1), 11–16.
18. Ma, X., Smith, L. M., Cai, L., Shi, S. Q., Li, H., Fei, B. Preparation of high-performance activated carbons using bamboo through one-step pyrolysis. *BioResources* **2019**, 14(1), 688–699.
19. Santana, G. M., Trugilho, P. F., Da Silva Borges, W. M., Bianchi, M. L., Paes, J. B., Nobre, J. R. C., De Medeiros Morais, R., Activated carbon from bamboo (*bambusa vulgaris*) waste using CO2 as activating agent for adsorption of methylene blue and phenol. *Ciênc. Florest.* **2019**, 29(2), 769–778.
20. Jawad, A. H., Abdulhameed, A. S., Statistical modeling of MB adsorption by high surface area mesoporous activated carbon from bamboo chip using KOH-assisted thermal activation. *Energy Ecol. Environ.* **2020**, 5(6), 456–469.
21. Efiyanti, L., Indrawan, D. A., Hastuti, N., Darmawan, S., The activated carbon produced from mayan bamboo (*Gigantochloa robusta Kurz*) and its application as dye removal. *IOP Conf. Ser.: Mater. Sci. Eng.* **2020**, 935, 012018.
22. Mi, B., Wang, J., Xiang, H., Liang, F., Yang, J., Feng, Z., Zhang, T., Hu, W., Liu, X., Liu, Z., Fei, B., Nitrogen self-doped activated carbons derived from bamboo shoots as adsorbent for methylene blue adsorption. *Molecules* **2019,** 24(16). 3012.
23. Zhang, Q., Zeng, Y., Xiao, X., Deng, P., He, Q., Zhang, T., Investigation on the Preparation and Adsorption Performance of Bamboo Fiber Based Activated Carbon. *Fibers Polym.* **2019**, 20(2), 293–301.
24. Chen, L., Ji, T., Mu, L., Shi, Y., Wang, H., Zhu, J. (2017). Pore size dependent molecular adsorption of cationic dye in biomass derived hierarchically porous carbon. *J. Environ. Manage.* **2017**, 196, 168–177.
25. Hata, M., Amano, Y., Thiravetyan, P., Machida, M., Preparation of Bamboo Chars and Bamboo Activated Carbons to Remove Color and COD from Ink Wastewater. *Water Environ. Res.* **2015**, 88(1), 87–96.
26. Tadesse, S., Ambo, D., Removal of Basic Dye from Aqueous Medium Using Activated Carbon from *Erythrina Brucei, Arundinaria Alpina* and *Manihot Esculenta*. *Food Sci. Qual. Manage.* **2019**, 86, 19–27.
27. Qanytah, Q. Syamsu, K., Fahma, F., Pari, G., Characterization of Ball-Milled Bamboo-Based Activated Carbon Treated with KMnO4 and KOH as Activating Agents. In *BioResources* **2020**, 15(4), 8303–8322
28. Santana, G. M., Lelis, R. C. C., Paes, J. B., Morais, R. de-M., Lopes, C. R., de Lima, C. R., Activated Carbon from Bamboo (*Bambusa vulgaris*) for Methylene Blue Removal: Prediction to The Environment Applications. *Ciênc. Florest.* **2018**., 1179–1191.
29. Kibami, D., Comparative study of low-cost adsorbents prepared indigenously from locally available bio-waste for the removal of methylene blue dye. *J. Water Sci. Environ. Technol*. **2017**, 02,213–225.
30. Li, Y., Pan, B., Miao, H., Xu, H., Liu, X., Shi, G., Single and Binary Dye Adsorption of Methylene Blue and Methyl Orange in Alcohol Aqueous Solution via Rice Husk Based Activated Carbon: Kinetics and Equilibrium Studies. *Chem. Res. Chinese U.* **2020**, 36(6), 1272–1278.
31. Alver, E., Metin, A. Ü., Brouers, F. (2020). Methylene blue adsorption on magnetic alginate/rice husk bio-composite. *Int. J. Biol. Macromol.* **2020**, 154, 104–113.
32. Basta, A. H., Lotfy, V. F., Hasanin, M. S., Trens, P., El-Saied, H., Efficient treatment of rice byproducts for preparing high-performance activated carbons. *J. Clean. Prod.* **2019**, 207, 284–295.
33. Liou, T. H., Wang, P. Y., Utilization of rice husk wastes in synthesis of graphene oxide-based carbonaceous nanocomposites. *Waste Manage.* **2020**, 108, 51–61.
34. Kaykioğlu, G., Güneş, E., Kinetic and equilibrium study of methylene blue adsorption using H2SO4− activated rice husk ash. *Desalin. Water Treat.* **2016**, 57(15), 7085–7097.
35. Thambiliyagodage, C. J., Cooray, V. Y., Perera, I. N., Wijesekera, R. D., Eco-Friendly Porous Carbon Materials for Wastewater Treatment. *In Lecture Notes in Civil Engineering* **2020**, 44, Springer Singapore.
36. Nworie, F. S., Nwabue, F. I., Oti, W., Mbam, E., Nwali, B. U., Removal of methylene blue from aqueous solution using activated rice husk biochar: Adsorption isotherms, kinetics and error analysis. *J. Chil. Chem. Soc.* **2019**, 64(1), 4365–4376.
37. Ahmad, T., Promi, S. i., Rumpa, I. J., Color Removal from Tannery Wastewater Using Activated Carbon Generated from Rice Husk, *World Environmental and Water Resource Congress* **2018.** 489.
38. Desalgne, A., Optimal Removal of Methylene Blue in Aqueous Solution Using Selected Rice Husk Activated Carbon from Pore Development. *Thesis* **2019**. Addis Ababa University, Ethiopia.
39. Ahmad, M. A., Basir, N. I., Yahaya, N. K. E., Microwave assisted rice husk based activated carbon for adsorption of methylene blue. *Int. J. Petrochemistry Res*. **2018,** 2(2), 162–164.
40. Murat, M., Ahmad, M. A., Idris, M. N., Optimization of preparation conditions for rice husk based activated carbons for the removal of methylene blue. *Int. J. Petrochemistry Res.* **2018**, 2(2), 186–188.
41. Ma, H. T., Ly, H. C., Ho, V. T. T., Pham, N. B., Nguyen, D. C., Vo, K. T. D., Tuan, P. D., Effect of the Carbonization and Activation Process on the Adsorption Capacity of Rice Husk Activated Carbon. *Vietnam J. Sci. Technol.* **2017**, 55(4), 494–502.
42. Bahago, N. A., Sorption Studies of Methylene Blue Using Activated Carbon Produced from Rice Husk., *Commun. Phy. Sci*. **2018**, 3, 91–96.
43. Ahiduzzaman, M., Sadrul Islam, A. K. M. Preparation of porous bio-char and activated carbon from rice husk by leaching ash and chemical activation. *SpringerPlus* **2016**, 5, 1248.