Supplementary Information

**Acid assisted-hydrothermal carbonization of solid waste from essential oils industry: optimization using *I*-optimal experimental design and removal dye application**

Faiçal El Ouadrhiri1\*, Ebraheem Abdu Musad Saleh2, Kakul Husain2, Abderrazzak Adachi1, Anouar Hmamou1, Ismail Hassan2, Marwa Mostafa Moharam2,3, Amal Lahkimi1

*1 Laboratory of Engineering, Molecular Organometallic Materials and Environment, Faculty of Sciences Dhar El Mehraz, Sidi Mohamed Ben Abdellah University, Fez, Morocco.*

*2 Chemistry Department, College of Arts & Science,* *Prince Sattam Bin Abdulaziz University, Wadi Al-Dawaser, Alkharj, Saudi Arabia.*

*3 Chemical and Electrochemical Processing Department, Central Metallurgical Research and Development Institute (CMRDI), P.O. Box 87, Helwan 11421, Egypt.* \*Corresponding author Email: [Faical.elouadrhiri@usmba.ac.ma](mailto:Faical.elouadrhiri@usmba.ac.ma)

**MATERIAL AND METHOD:**

**Optimal design of experimental**

Tableau S1 : Facteur de severite en fonction de la temperature et le temps

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Niveau | 1 | 2 | 3 | 4 | 5 | 6 |
| (°C) | 180 | 195 | 210 | 210 | 210 | 210 |
| (min) | 180 | 180 | 180 | 60 | 120 | 240 |
| SF | 4.61 | 5.05 | 5.49 | 5.02 | 5.32 | 5.62 |

**Adsorption study**

Table S2:isotherm and kinetic equations used in the adsorption of HCop and AHCop

|  |  |  |
| --- | --- | --- |
| Utility | Equation | reference |
| Pseudo-First Order |  | [1] |
| Pseudo-Second Order |  | [2] |
| Modele de Langmuir |  | [3] |
| Modele de Freundlich |  | [4] |
| Arrhenius équation |  | [5] |

C0 (mg.L-1) and Ce,t (mg.L-1) are the initial and equilibrium concentrations respectively. m (g) is the mass of carbocatalyst V (L) is the volume of Dye. Qe is the equilibrium quantity. KL (L.mg-1) is a direct measure of the adsorption intensity.Qmax is the maximum adsorption capacity. KF ((mg.g-1)(L.mg-1)1/n) is the adsorption capacity. (1/nF): is the intensity of adsorption for 1/nF=0 irreversible, 1/nF>1 unfavorable and for 0<1/nF<1 the adsorption is favorable.

**RESULT AND DISCUSSION:**

**Numerical Optimization of MY and CRR model**

Table S3 : Optimization constraints for factors and responses

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Goal | Importance | Graph |
| X1 : HTCcat | minimize | 3 |  |
| X2 : SF | minimize | 1 |  |
| MY (%) | None | 1 |  |
| CRR (%) | maximize | 3 |  |

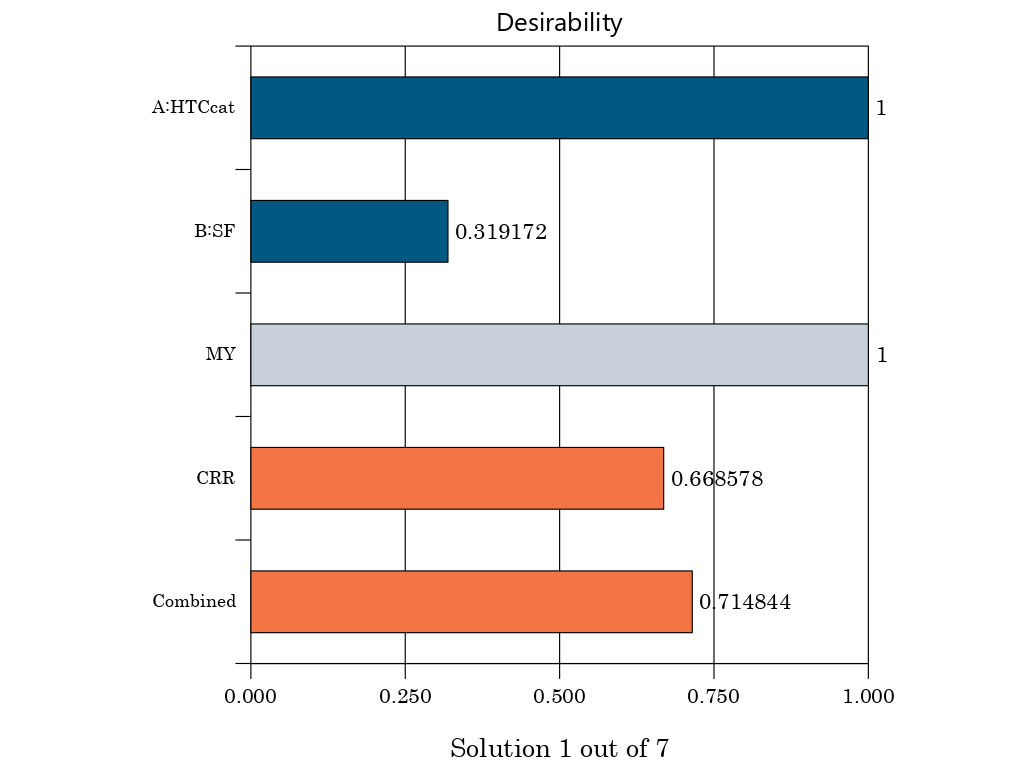
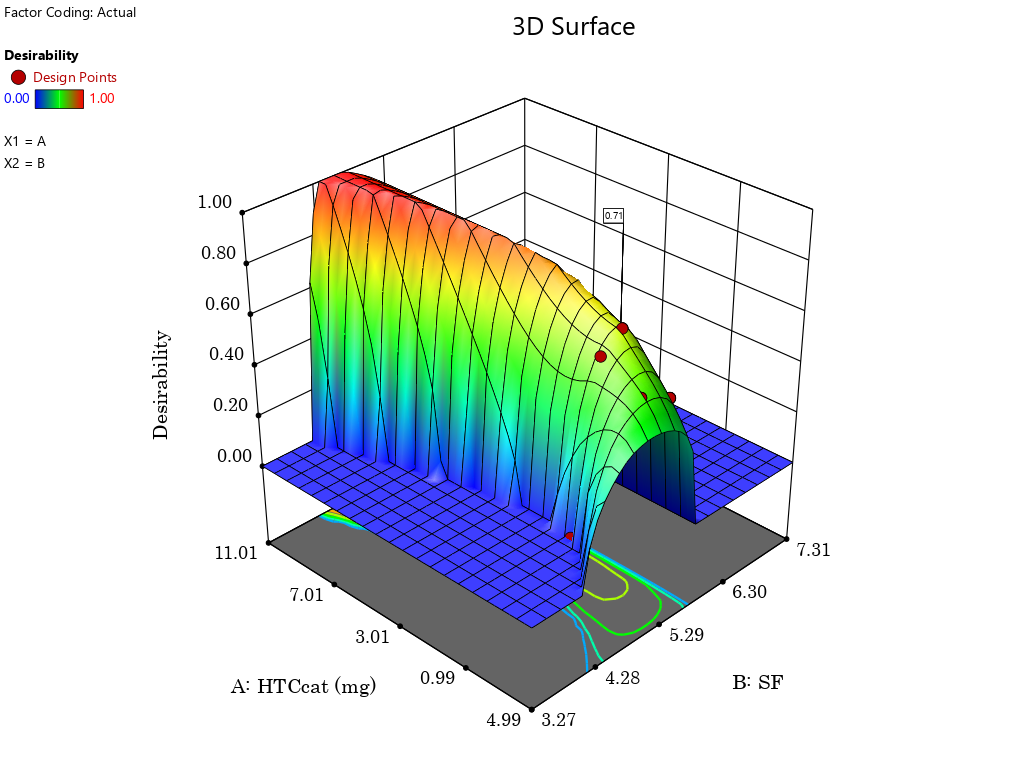


Figure S1 : (a) bar histogram (b) graphical representation of the desirability function for the optimal solution (D=0,739).



Figure S2 : N2 Adsorption-desorption and PSD profil of HCop

Table S4:  Maximum adsorption capacity of MB dye by various low-cost adsorbents.

|  |  |  |  |
| --- | --- | --- | --- |
| Adsorbent | SBET (m2.g-1) | Qm (mg.g-1) | reference |
| Activated-hydrochar from *surgane bagasse* | 15.34 | 357.14 | [6] |
| Treated *sugarcane bagasse* | 1.018 | 58.9 | [7] |
| Activated hydrochar from *loblolly pine* | 1703 | 719.4 | [8] |
| Hydrochar from *orange peel* | 46.16 | 66.23 | [9] |
| Hydrochar from *orange peel* | 34.08 | 36.63 |
| Activated-hydrochar from solid waste (essential oil industry) | 989.81 | 588.24 | **This study** |

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