**SUPORTING INFORMATION**

**Machine Learning Implemented Exploration of the Adsorption Mechanism of Carbon Dioxide onto Porous Carbons**

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**Fig. S1.** Structural schematic diagram of gradient boosting decision tree (GBDT) model. Information using Shahani et al. [1].



**Fig. S2.** Structural schematic diagram of extreme gradient boosting (XGB) model. Information using Shahani et al. [1].

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**Fig. S8.** Structural schematic diagram of 5-fold cross validation.

**Table S1.** Parameters of the machine learning (ML) model: gradient boosting decision tree (GBDT) [3].

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| alpha | 0.9 |
| ccp\_alpha | 0.0 |
| criterion | friedman\_mse |
| init | None |
| learning\_rate | 0.05 |
| loss | squared\_error |
| max\_depth | 5 |
| max\_features | None |
| max\_leaf\_nodes | None |
| min\_impurity\_decrease | 0.0 |
| min\_samples\_leaf | 1 |
| min\_samples\_split | 2 |
| min\_weight\_fraction\_leaf | 0.0 |
| n\_estimators | 600 |
| n\_iter\_no\_change | None |
| random\_state | 42 |
| subsample | 0.5 |
| tol | 0.0001 |
| validation\_fraction | 0.1 |
| verbose | 0 |
| warm\_start | False |

**Table S2.** Parameters of the machine learning (ML) model: light boost gradient machine (LBGM) [3].

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| boosting\_type | gbdt |
| class\_weight | none |
| colsample\_bytree | 1.0 |
| importance\_type | split |
| learning\_rate | 0.05 |
| max\_depth | 10 |
| min\_child\_samples | 20 |
| min\_child\_weight | 0.001 |
| min\_split\_gain | 0.0 |
| n\_estimators | 600 |
| n\_jobs | -1 |
| num\_leaves | 5 |
| objective | none |
| random\_state | none |
| reg\_alpha | 0.0 |
| reg\_lambda | 0.8 |
| silent | warn |
| subsample | 0.1 |
| subsample\_for\_bin | 200000 |
| subsample\_freq | 0 |

**Table S3.** Parameters of the machine learning (ML) model: extreme gradient boosting (XGB) [3].

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| objective | reg:squarederror |
| base\_score | 0.5 |
| booster | gbtree |
| callbacks | none |
| colsample\_bylevel | 1 |
| colsample\_bynode | 1 |
| colsample\_bytree | 1 |
| early\_stopping\_rounds | none |
| enable\_categorical | false |
| eval\_metric | rmse |
| gamma | 0 |
| gpu\_id | -1 |
| grow\_policy | depthwise |
| importance\_type | none |
| learning\_rate | 0.3 |
| max\_bin | 256 |
| max\_cat\_to\_onehot | 4 |
| max\_delta\_step | 0 |
| max\_depth | 4 |
| max\_leaves | 0 |
| min\_child\_weight | 1 |
| missing | nan |
| monotone\_constraints | () |
| n\_estimators | 300 |
| n\_jobs | 0 |
| num\_parallel\_tree | 1 |
| predictor | auto |
| random\_state | 60 |
| reg\_alpha | 0 |
| reg\_lambda | 1 |
| sampling\_method | uniform |
| scale\_pos\_weight | 1 |
| subsample | 0.5 |
| tree\_method | exact |
| validate\_parameters | 1 |
| verbosity | none |
| seed | 60 |

**Table S4.** Parameters of the machine learning (ML) model: random forest (RF) [3].

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| bootstrap | true |
| ccp\_alpha | 0.0 |
| criterion | squared\_error |
| max\_depth | none |
| max\_features | sqrt |
| max\_leaf\_nodes | none |
| max\_samples | none |
| min\_impurity\_decrease | 0.0 |
| min\_samples\_leaf | 1 |
| min\_samples\_split | 2 |
| min\_weight\_fraction\_leaf | 0.0 |
| n\_estimators | 300 |
| n\_jobs | none |
| oob\_score | false |
| random\_state | none |
| verbose | 0 |
| warm\_start | false |

**Table S5.** Parameters of the machine learning (ML) model: categorical boosting (Catboost) and adaptive boosting (Adaboost) [3].

|  |  |
| --- | --- |
| Catboost | |
| loss\_function | RMSE |
| Adaboost | |
| base\_estimator | none |
| learning\_rate | 0.01 |
| loss | exponential |
| n\_estimators | 200 |
| random\_state | none |

**Table S6.** Data used for during machine learning (ML) implemented exploration of adsorption mechanism of carbon dioxide (CO2) onto porous carbons. This data is represented on the basis of porous carbon’s properties (surface area (SA) (m2/g), TPV (total pore volume) (cm3/g), MPV (micro-pore volume) (cm3/g), C%, H%, N%, O%), CO2 adsorption conditions (T (℃), P (bar)), and CO2 uptake (mmol/g). Porous carbon’s properties and adsorption conditions are the input features, and CO2 uptake is the predicted variable.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **Porous carbon’s properties** | | | | | | | | **Adsorption conditions** | |  |  |
| **S. No.** | **Feedstock** | **Heat treatment (℃)** | **Activation** | **Material type** | **SA**  **(m2/g)** | **TPV (cm3/g)** | **MPV**  **(cm3/g)** | **C%** | **H%** | **N%** | **O%** | **T (℃)** | **P (bar)** | **CO2 uptake (mmol/g)** | **Ref.** |
| 1 | Wood chip | 800- 1000 | KOH | Hierarchical | 1281.6 | 0.71 | 0.32 | 69.22 | 3.99 | 0.08 | 26.3 | 25 | 1 | 2.63 | [4] |
|  |  |  | KOH and CO2 |  | 1012.6 | 0.56 | 0.22 | 64.83 | 3.64 | 0.38 | 30.77 | 25 | 1 | 2.59 |  |
|  | Wood chip and chicken manure |  | KOH |  | 1408.8 | 0.83 | 0.36 | 72.41 | 3.63 | 0.01 | 23.59 | 25 | 1 | 2.92 |  |
|  |  |  | KOH and CO2 |  | 1403.9 | 0.85 | 0.33 | 69.51 | 4.35 | 0.76 | 24.94 | 25 | 1 | 2.44 |  |
| 2 | Food waste and wood |  | KOH | Hierarchical | 841.3 | 0.36 |  | 68.43 | 0 | 31.09 | 0.48 | 25 | 1 | 3.23 | [5] |
|  |  |  | KOH and CO2 |  | 667.4 | 0.29 |  | 61.32 | 0 | 38.15 | 0.53 | 25 | 1 | 2.73 |  |
| 3 | Spent coffee |  | K2CO3 | Microporous | 645 | 0.26 | 0.25 | 70.86 | 1.71 | 3.19 | 14.72 | 25 | 1 | 3.45 | [6] |
|  |  |  |  |  | 750 | 0.3 | 0.29 | 83.88 | 1.63 | 3.27 | 5.3 | 25 | 1 | 3.65 |  |
|  |  |  |  |  | 1259 | 0.52 | 0.49 | 87.56 | 1.06 | 1.87 | 0.23 | 25 | 1 | 4.33 |  |
|  |  |  |  |  | 1476 | 0.61 | 0.6 | 91.62 | 0.8 | 1.67 | 0 | 25 | 1 | 4.54 |  |
|  |  |  |  |  | 1692 | 0.71 | 0.68 | 94.51 | 0.58 | 1.51 | 0 | 25 | 1 | 4.46 |  |
|  |  |  |  |  | 2337 | 1.15 | 0.85 | 82.66 | 0.59 | 1.55 | 0 | 25 | 1 | 3.78 |  |
|  |  |  |  |  | 645 | 0.26 | 0.25 | 70.86 | 1.71 | 3.19 | 14.72 | 25 | 0.15 | 1.43 |  |
|  |  |  |  |  | 750 | 0.3 | 0.29 | 83.88 | 1.63 | 3.27 | 5.3 | 25 | 0.15 | 1.46 |  |
|  |  |  |  |  | 1259 | 0.52 | 0.49 | 87.56 | 1.06 | 1.87 | 0.23 | 25 | 0.15 | 1.36 |  |
|  |  |  |  |  | 1476 | 0.61 | 0.6 | 91.62 | 0.8 | 1.67 | 0 | 25 | 0.15 | 1.3 |  |
|  |  |  |  |  | 1692 | 0.71 | 0.68 | 94.51 | 0.58 | 1.51 | 0 | 25 | 0.15 | 1.2 |  |
|  |  |  |  |  | 2337 | 1.15 | 0.85 | 82.66 | 0.59 | 1.55 | 0 | 25 | 0.15 | 0.92 |  |
| 4 | Pine sawdust | 700 | KOH | Hierarchical | 1728.66 | 0.7 | 0.67 | 93.4 | 0.73 | 0.89 | 6.79 | 25 | 1 | 4.21 | [7] |
|  |  |  |  |  | 2279.52 | 0.99 | 0.91 | 96.96 | 0.18 | 0.99 | 4.51 | 25 | 1 | 3.46 |  |
|  |  |  |  |  | 2330.89 | 1.91 | 0.98 | 87.57 | 0.17 | 1.3 | 7.35 | 25 | 1 | 2.45 |  |
| 5 | Date | 500 | KOH | Hierarchical | 2112 | 0.94 | 0.86 | 82.84 | 2.06 | 0.75 | 14.35 | 25 | 1 | 4.18 | [8] |
|  |  |  |  |  | 3255 | 1.65 | 1.29 | 79.46 | 1.7 | 0.04 | 18.8 | 25 | 1 | 3.35 |  |
|  |  |  |  |  | 3337 | 2.05 | 0.54 | 89.4 | 1.41 | 0.16 | 9.03 | 25 | 1 | 2.9 |  |
|  |  | 800 |  |  | 1634 | 0.76 | 0.56 | 82.49 | 2.02 | 0.82 | 14.67 | 25 | 1 | 4.14 |  |
|  |  |  |  |  | 2367 | 1.15 | 0.83 | 74.01 | 1.93 | 0.67 | 13 | 25 | 1 | 4.36 |  |
|  |  |  |  |  | 2844 | 1.63 | 0.89 | 73.43 | 2.03 | 0.67 | 23.88 | 25 | 1 | 3.65 |  |
| 6 | Bee collected pollen | 800 | KOH | Microporous | 232 | 0.11 | 0.09 | 80.82 | 1.48 | 2.34 | 15.36 | 25 | 1 | 1.77 | [9] |
|  |  |  |  |  | 332 | 0.16 | 0.12 | 76.25 | 0 | 1.89 | 21.86 | 25 | 1 | 2.1 |  |
|  |  |  |  |  | 937 | 0.4 | 0.38 | 77.57 | 0 | 1.54 | 20.89 | 25 | 1 | 3.38 |  |
|  |  |  |  |  | 1214 | 0.53 | 0.48 | 79.37 | 0 | 1.18 | 19.45 | 25 | 1 | 3.4 |  |
|  |  |  |  |  | 1460 | 0.63 | 0.53 | 93.1 | 0 | 0.31 | 6.59 | 25 | 1 | 3.42 |  |
|  |  |  |  |  | 232 | 0.11 | 0.09 | 80.82 | 1.48 | 2.34 | 15.36 | 25 | 0.15 | 0.98 |  |
|  |  |  |  |  | 332 | 0.16 | 0.12 | 76.25 | 0 | 1.89 | 21.86 | 25 | 0.15 | 1.04 |  |
|  |  |  |  |  | 937 | 0.4 | 0.38 | 77.57 | 0 | 1.54 | 20.89 | 25 | 0.15 | 1.18 |  |
|  |  |  |  |  | 1214 | 0.53 | 0.48 | 79.37 | 0 | 1.18 | 19.45 | 25 | 0.15 | 0.85 |  |
|  |  |  |  |  | 1460 | 0.63 | 0.53 | 93.1 | 0 | 0.31 | 6.59 | 25 | 0.15 | 0.69 |  |
| 7 | Biomass tar |  | Cao/KOH | Hierarchical | 1898 | 1.52 | 0.43 | 82.85 | 0 | 0 | 17.15 | 25 | 1 | 2.44 | [10] |
|  |  |  |  |  | 1790 | 1.21 | 0.48 | 93.76 | 0 | 0 | 6.24 | 25 | 1 | 2.71 |  |
|  |  |  |  |  | 2424 | 1.38 | 0.51 | 95.01 | 0 | 0 | 4.99 | 25 | 1 | 2.67 |  |
|  |  |  |  |  | 2358 | 1.85 | 0.49 | 95.14 | 0 | 0 | 4.86 | 25 | 1 | 2.92 |  |
|  |  |  |  |  | 1829 | 1.25 | 0.49 | 96.75 | 0 | 0 | 3.25 | 25 | 1 | 3.13 |  |
|  |  |  |  |  | 1684 | 1.43 | 0.48 | 95.25 | 0 | 0 | 4.75 | 25 | 1 | 2.75 |  |
|  |  |  |  |  | 1898 | 1.52 | 0.43 | 82.85 | 0 | 0 | 17.15 | 25 | 0.15 | 0.8 |  |
|  |  |  |  |  | 1790 | 1.21 | 0.48 | 93.76 | 0 | 0 | 6.24 | 25 | 0.15 | 0.74 |  |
|  |  |  |  |  | 2424 | 1.38 | 0.51 | 95.01 | 0 | 0 | 4.99 | 25 | 0.15 | 0.7 |  |
|  |  |  |  |  | 2358 | 1.85 | 0.49 | 95.14 | 0 | 0 | 4.86 | 25 | 0.15 | 1.01 |  |
|  |  |  |  |  | 1829 | 1.25 | 0.49 | 96.75 | 0 | 0 | 3.25 | 25 | 0.15 | 1.2 |  |
|  |  |  |  |  | 1684 | 1.43 | 0.48 | 95.25 | 0 | 0 | 4.75 | 25 | 0.15 | 0.68 |  |
|  |  |  |  |  | 1898 | 1.52 | 0.43 | 82.85 | 0 | 0 | 17.15 | 0 | 1 | 3.81 |  |
|  |  |  |  |  | 1790 | 1.21 | 0.48 | 93.76 | 0 | 0 | 6.24 | 0 | 1 | 4.4 |  |
|  |  |  |  |  | 2424 | 1.38 | 0.51 | 95.01 | 0 | 0 | 4.99 | 0 | 1 | 4.1 |  |
|  |  |  |  |  | 2358 | 1.85 | 0.49 | 95.14 | 0 | 0 | 4.86 | 0 | 1 | 4.77 |  |
|  |  |  |  |  | 1829 | 1.25 | 0.49 | 96.75 | 0 | 0 | 3.25 | 0 | 1 | 5.03 |  |
|  |  |  |  |  | 1684 | 1.43 | 0.48 | 95.25 | 0 | 0 | 4.75 | 0 | 1 | 4.62 |  |
| 8 | Flesh by sunflower receptacle and sunflower stalk | 500 | KOH | Hierarchical | 3072 | 1.77 | 0.78 | 91.02 | 2.71 | 0.4 | 5.87 | 25 | 1 | 2.78 | [11] |
|  |  |  |  |  | 2730 | 1.84 | 1.12 | 94.5 | 0.95 | 0.8 | 3.75 | 25 | 1 | 2.34 |  |
|  |  | 1000 |  |  | 654 | 0.46 | 0.36 | 77.12 | 1.08 | 0.75 | 21.05 | 25 | 1 | 3.08 |  |
|  |  | 500 |  |  | 3072 | 1.77 | 0.78 | 91.02 | 2.71 | 0.4 | 5.87 | 0 | 1 | 4.09 |  |
|  |  |  |  |  | 2730 | 1.84 | 1.12 | 94.5 | 0.95 | 0.8 | 3.75 | 0 | 1 | 4.08 |  |
|  |  | 1000 |  |  | 654 | 0.46 | 0.36 | 77.12 | 1.08 | 0.75 | 21.05 | 0 | 1 | 4.52 |  |
| 9 | Biomass tar |  | KOH | Microporous | 660 | 0.28 | 0.24 | 83.48 | 0.01 | 3.53 | 12.98 | 25 | 1 | 2.94 | [12] |
|  |  |  |  |  | 1076 | 0.44 | 0.38 | 84.57 | 2.94 | 3.03 | 9.46 | 25 | 1 | 4.11 |  |
|  |  |  |  |  | 1268 | 0.55 | 0.5 | 90.49 | 0 | 2.12 | 7.39 | 25 | 1 | 3.64 |  |
|  |  |  |  |  | 1480 | 0.71 | 0.48 | 89.42 | 1.46 | 2.08 | 7.04 | 25 | 1 | 3.31 |  |
|  |  |  |  |  | 1161 | 0.38 | 0.35 | 88.44 | 0.01 | 3.02 | 8.53 | 25 | 1 | 3.69 |  |
|  |  |  |  |  | 1804 | 0.85 | 0.66 | 89.93 | 0 | 2 | 8.07 | 25 | 1 | 3.16 |  |
|  |  |  |  |  | 1857 | 0.87 | 0.48 | 92.01 | 0 | 1.32 | 6.67 | 25 | 1 | 3.06 |  |
|  |  |  |  |  | 660 | 0.28 | 0.24 | 83.48 | 0.01 | 3.53 | 12.98 | 25 | 0.15 | 0.74 |  |
|  |  |  |  |  | 1076 | 0.44 | 0.38 | 84.57 | 2.94 | 3.03 | 9.46 | 25 | 0.15 | 1.64 |  |
|  |  |  |  |  | 1268 | 0.55 | 0.5 | 90.49 | 0 | 2.12 | 7.39 | 25 | 0.15 | 1.22 |  |
|  |  |  |  |  | 1480 | 0.71 | 0.48 | 89.42 | 1.46 | 2.08 | 7.04 | 25 | 0.15 | 1.52 |  |
|  |  |  |  |  | 1161 | 0.38 | 0.35 | 88.44 | 0.01 | 3.02 | 8.53 | 25 | 0.15 | 1.38 |  |
|  |  |  |  |  | 1804 | 0.85 | 0.66 | 89.93 | 0 | 2 | 8.07 | 25 | 0.15 | 0.96 |  |
|  |  |  |  |  | 1857 | 0.87 | 0.48 | 92.01 | 0 | 1.32 | 6.67 | 25 | 0.15 | 0.92 |  |
|  |  |  |  |  | 660 | 0.28 | 0.24 | 83.48 | 0.01 | 3.53 | 12.98 | 0 | 1 | 4.22 |  |
|  |  |  |  |  | 1076 | 0.44 | 0.38 | 84.57 | 2.94 | 3.03 | 9.46 | 0 | 1 | 6.02 |  |
|  |  |  |  |  | 1268 | 0.55 | 0.5 | 90.49 | 0 | 2.12 | 7.39 | 0 | 1 | 5.43 |  |
|  |  |  |  |  | 1480 | 0.71 | 0.48 | 89.42 | 1.46 | 2.08 | 7.04 | 0 | 1 | 5.41 |  |
|  |  |  |  |  | 1161 | 0.38 | 0.35 | 88.44 | 0.01 | 3.02 | 8.53 | 0 | 1 | 5.82 |  |
|  |  |  |  |  | 1804 | 0.85 | 0.66 | 89.93 | 0 | 2 | 8.07 | 0 | 1 | 5.2 |  |
|  |  |  |  |  | 1857 | 0.87 | 0.48 | 92.01 | 0 | 1.32 | 6.67 | 0 | 1 | 5.04 |  |
| 10 | Banana stems and fiber | 700 |  | Microporous | 909 | 0.44 | 0.32 | 79.5 | 1.5 | 0 | 19 | 25 | 1 | 3.2 | [13] |
|  |  |  |  |  | 1260 | 0.81 | 0.56 | 84 | 2 | 0 | 14 | 25 | 1 | 5 |  |
|  |  |  |  |  | 909 | 0.44 | 0.32 | 79.5 | 1.5 | 0 | 19 | 0 | 1 | 5.3 |  |
|  |  |  |  |  | 1260 | 0.81 | 0.56 | 84 | 2 | 0 | 14 | 0 | 1 | 7.1 |  |
| 11 | Cellulose fiber and wood |  | Steam | Microporous | 473 | 0.2 | 0.17 | 88.4 | 2.2 | 0 | 9.4 | 25 | 1.01 | 1.72 | [14] |
|  |  |  |  |  | 593 | 0.25 | 0.21 | 83.7 | 0.6 | 0 | 15.7 | 25 | 1.01 | 2.33 |  |
|  |  |  |  |  | 217 | 0.12 | 0.13 | 89.6 | 2.6 | 1 | 6.8 | 25 | 1.01 | 1.12 |  |
|  |  |  |  |  | 473 | 0.2 | 0.17 | 88.4 | 2.2 | 0 | 9.4 | 25 | 0.15 | 0.7 |  |
|  |  |  |  |  | 593 | 0.25 | 0.21 | 83.7 | 0.6 | 0 | 15.7 | 25 | 0.15 | 0.9 |  |
|  |  |  |  |  | 217 | 0.12 | 0.13 | 89.6 | 2.6 | 1 | 6.8 | 25 | 0.15 | 0.5 |  |
| 12 | Corn stover | 250 | KOH | Microporous | 955 | 0.43 | 0.31 | 57.46 | 3.37 | 0.66 | 38.51 | 0 | 1 | 4.93 | [15] |
|  |  |  |  |  | 1539 | 0.72 | 0.48 | 59.2 | 3.7 | 0.34 | 36.76 | 0 | 1 | 6.8 |  |
|  |  |  |  |  | 2442 | 1.56 | 0.86 | 60.41 | 3.91 | 0.24 | 35.44 | 0 | 1 | 7.14 |  |
|  |  |  |  |  | 2225 | 1.11 | 0.49 | 64.9 | 3.12 | 0.24 | 31.74 | 0 | 1 | 5.79 |  |
|  |  |  |  |  | 1543 | 0.71 | 0.61 | 66.56 | 2.99 | 0.86 | 29.59 | 0 | 1 | 5.06 |  |
|  |  |  |  |  | 2201 | 1.31 | 0.69 | 56.55 | 3.03 | 0.31 | 40.11 | 0 | 1 | 6.22 |  |
|  |  |  |  |  | 2170 | 1.27 | 0.66 | 54.94 | 2.19 | 0.32 | 42.55 | 0 | 1 | 4.86 |  |
|  |  |  |  |  | 1630 | 0.69 | 0.6 | 76.91 | 2.73 | 0.2 | 20.16 | 0 | 1 | 6.47 |  |
|  |  |  |  |  | 2132 | 1.13 | 0.7 | 59.22 | 3.88 | 0.23 | 36.67 | 0 | 1 | 6.85 |  |
|  |  |  |  |  | 1862 | 0.81 | 0.69 | 58.22 | 3.79 | 0.22 | 37.77 | 0 | 1 | 6.32 |  |
| 13 | Lotus stem | 180 | KOH | Hierarchical | 2091 | 0.87 | 0.65 | 90.49 | 0 | 0 | 9.51 | 25 | 1 | 3.85 | [16] |
|  |  |  |  |  | 2893 | 1.59 | 0.7 | 88.8 | 0 | 0 | 11.2 | 25 | 1 | 2.84 |  |
|  |  |  |  |  | 2091 | 0.87 | 0.65 | 90.49 | 0 | 0 | 9.51 | 0 | 1 | 6.17 |  |
|  |  |  |  |  | 2893 | 1.59 | 0.7 | 88.8 | 0 | 0 | 11.2 | 0 | 1 | 4.61 |  |
| 14 | Sawdust | 400 | KOH | Microporous | 1511 | 0.65 | 0.54 | 78.2 | 1.9 | 0 | 19.9 | 25 | 1 | 4.3 | [17] |
|  |  |  |  |  | 1830 | 0.78 | 0.67 | 83.4 | 0.9 | 0 | 15.7 | 25 | 1 | 4.9 |  |
|  |  |  |  |  | 2163 | 0.93 | 0.74 | 88.1 | 0.4 | 0 | 11.5 | 25 | 1 | 4.7 |  |
|  |  |  |  |  | 2610 | 1.15 | 0.74 | 88.7 | 0.4 | 0 | 10.9 | 25 | 1 | 4 |  |
|  |  |  |  |  | 1511 | 0.65 | 0.54 | 78.2 | 1.9 | 0 | 19.9 | 25 | 0.15 | 1.2 |  |
|  |  |  |  |  | 1830 | 0.78 | 0.67 | 83.4 | 0.9 | 0 | 15.7 | 25 | 0.15 | 1.1 |  |
|  |  |  |  |  | 2163 | 0.93 | 0.74 | 88.1 | 0.4 | 0 | 11.5 | 25 | 0.15 | 1.1 |  |
|  |  |  |  |  | 2610 | 1.15 | 0.74 | 88.7 | 0.4 | 0 | 10.9 | 25 | 0.15 | 0.9 |  |
| 15 | Vine shoot | 600 | CO2 and KOH | Microporous | 2.48 |  |  | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 2.18 | [18] |
|  |  |  |  |  | 46.3 |  |  | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 2.21 |  |
|  |  |  |  |  | 374 | 0.19 | 0.11 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 3.45 |  |
|  |  |  |  |  | 538 | 0.24 | 0.18 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 3.19 |  |
|  |  |  |  |  | 1032 | 0.49 | 0.35 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 4.38 |  |
|  |  |  |  |  | 864 | 0.41 | 0.28 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 3.74 |  |
|  |  |  |  |  | 1439 | 0.67 | 0.49 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 6.08 |  |
|  |  |  |  |  | 704 | 0.29 | 0.24 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 4.16 |  |
|  |  |  |  |  | 1101 | 0.54 | 0.38 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 5.36 |  |
|  |  |  |  |  | 1305 | 0.53 | 0.45 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 6.04 |  |
|  |  |  |  |  | 1671 | 0.67 | 0.59 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 1.01 | 5.4 |  |
|  |  |  |  |  | 2.48 |  |  | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 1.18 |  |
|  |  |  |  |  | 46.3 |  |  | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 1.2 |  |
|  |  |  |  |  | 374 | 0.19 | 0.11 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 1.68 |  |
|  |  |  |  |  | 538 | 0.24 | 0.18 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 1.76 |  |
|  |  |  |  |  | 1032 | 0.49 | 0.35 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 1.92 |  |
|  |  |  |  |  | 864 | 0.41 | 0.28 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 1.78 |  |
|  |  |  |  |  | 1439 | 0.67 | 0.49 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 2.27 |  |
|  |  |  |  |  | 704 | 0.29 | 0.24 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 2.16 |  |
|  |  |  |  |  | 1101 | 0.54 | 0.38 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 2.42 |  |
|  |  |  |  |  | 1305 | 0.53 | 0.45 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 2.25 |  |
|  |  |  |  |  | 1671 | 0.67 | 0.59 | 47.1 | 5.29 | 0.66 | 46.39 | 0 | 0.15 | 2.25 |  |
| 16 | Arundo donax stem |  | KOH | Microporous | 637 | 0.35 | 0.25 | 84.2 | 0 | 0.76 | 15.04 | 0 | 1 | 4 | [19] |
|  |  |  |  |  | 1122 | 0.59 | 0.5 | 84.7 | 0 | 0.87 | 14.43 | 0 | 1 | 6.3 |  |
|  |  |  |  |  | 849 | 0.5 | 0.31 | 54.9 | 0 | 0.53 | 44.57 | 0 | 1 | 3.7 |  |
| 17 | Black locust | 650 | Steam and KOH | Hierarchical | 1175 | 0.55 | 0.49 | 83.43 | 1.52 | 0 | 15.05 | 25 | 1 | 1.85 | [20] |
|  |  |  |  |  | 2064 | 0.98 | 0.87 | 74.36 | 1.15 | 0 | 24.49 | 25 | 1 | 3.75 |  |
|  |  |  |  |  | 1175 | 0.55 | 0.49 | 83.43 | 1.52 | 0 | 15.05 | 0 | 1 | 2.79 |  |
|  |  |  |  |  | 2064 | 0.98 | 0.87 | 74.36 | 1.15 | 0 | 24.49 | 0 | 1 | 5.86 |  |
|  |  |  |  |  | 1175 | 0.55 | 0.49 | 83.43 | 1.52 | 0 | 15.05 | 25 | 0.15 | 0.75 |  |
|  |  |  |  |  | 2064 | 0.98 | 0.87 | 74.36 | 1.15 | 0 | 24.49 | 25 | 0.15 | 1.21 |  |
|  |  |  |  |  | 1175 | 0.55 | 0.49 | 83.43 | 1.52 | 0 | 15.05 | 0 | 0.15 | 1.42 |  |
|  |  |  |  |  | 2064 | 0.98 | 0.87 | 74.36 | 1.15 | 0 | 24.49 | 0 | 0.15 | 2.43 |  |
| 18 | Empty fruit bunch | 150-350 | KOH | Microporous | 1163 | 0.23 | 0.1 | 77.3 | 3.5 | 2 | 13.3 | 25 | 1.01 | 0.66 | [21] |
|  |  |  |  |  | 2239 | 0.88 | 0.19 | 83.5 | 2.6 | 2.7 | 11.3 | 25 | 1.01 | 0.85 |  |
|  |  |  |  |  | 1720 | 0.56 | 0.15 | 85.9 | 2.2 | 3.1 | 8.8 | 25 | 1.01 | 2.81 |  |
|  |  |  |  |  | 1322 | 0.78 | 0.23 | 80.9 | 2.9 | 2.4 | 13.3 | 25 | 1.01 | 3.4 |  |
|  |  |  |  |  | 2510 | 1.05 | 0.55 | 84.6 | 1.9 | 2.4 | 11.1 | 25 | 1.01 | 3.71 |  |
|  |  |  |  |  | 2100 | 0.78 | 0.29 | 87.8 | 1.7 | 3.5 | 7 | 25 | 1.01 | 2.18 |  |
| 19 | Gelatin and starch | 450 | KOH | Hierarchical | 1714 | 0.83 |  | 75.9 | 2.17 | 0.65 | 12.76 | 25 | 1 | 3.28 | [22] |
|  |  |  |  |  | 1636 | 0.51 |  | 71.4 | 3.75 | 3 | 21.12 | 25 | 1 | 3.84 |  |
|  |  |  |  |  | 1957 | 0.79 |  | 71.2 | 1.97 | 1.97 | 19.57 | 25 | 1 | 3.45 |  |
|  |  |  |  |  | 1294 | 0.63 |  | 74.48 | 2.24 | 2.42 | 16.6 | 25 | 1 | 3.3 |  |
|  |  |  |  |  | 714 | 0.4 |  | 70.85 | 2.43 | 2.43 | 18.9 | 25 | 1 | 2.81 |  |
| 20 | Rice husk | 520 | KOH | Microporous | 774 | 0.41 | 0.3 | 74.2 | 2.2 | 0.75 | 22.85 | 25 | 1 | 3.53 | [23] |
|  |  |  |  |  | 1041 | 0.53 | 0.42 | 76.1 | 1.9 | 0.48 | 21.52 | 25 | 1 | 4.16 |  |
|  |  |  |  |  | 1199 | 0.6 | 0.48 | 72 | 1.5 | 0.36 | 26.14 | 25 | 1 | 3.87 |  |
|  |  |  |  |  | 2695 | 1.14 | 1.11 | 82.7 | 1.8 | 0.45 | 15.05 | 25 | 1 | 3.71 |  |
|  |  |  |  |  | 774 | 0.41 | 0.3 | 74.2 | 2.2 | 0.75 | 22.85 | 25 | 0.15 | 1.51 |  |
|  |  |  |  |  | 1041 | 0.53 | 0.42 | 76.1 | 1.9 | 0.48 | 21.52 | 25 | 0.15 | 1.55 |  |
|  |  |  |  |  | 1199 | 0.6 | 0.48 | 72 | 1.5 | 0.36 | 26.14 | 25 | 0.15 | 1.28 |  |
|  |  |  |  |  | 2695 | 1.14 | 1.11 | 82.7 | 1.8 | 0.45 | 15.05 | 25 | 0.15 | 0.92 |  |
|  |  |  |  |  | 774 | 0.41 | 0.3 | 74.2 | 2.2 | 0.75 | 22.85 | 25 | 0.1 | 1.24 |  |
|  |  |  |  |  | 1041 | 0.53 | 0.42 | 76.1 | 1.9 | 0.48 | 21.52 | 25 | 0.1 | 1.21 |  |
|  |  |  |  |  | 1199 | 0.6 | 0.48 | 72 | 1.5 | 0.36 | 26.14 | 25 | 0.1 | 1.01 |  |
|  |  |  |  |  | 2695 | 1.14 | 1.11 | 82.7 | 1.8 | 0.45 | 15.05 | 25 | 0.1 | 0.69 |  |
|  |  |  |  |  | 774 | 0.41 | 0.3 | 74.2 | 2.2 | 0.75 | 22.85 | 0 | 1 | 4.88 |  |
|  |  |  |  |  | 1041 | 0.53 | 0.42 | 76.1 | 1.9 | 0.48 | 21.52 | 0 | 1 | 5.63 |  |
|  |  |  |  |  | 1199 | 0.6 | 0.48 | 72 | 1.5 | 0.36 | 26.14 | 0 | 1 | 6.02 |  |
|  |  |  |  |  | 2695 | 1.14 | 1.11 | 82.7 | 1.8 | 0.45 | 15.05 | 0 | 1 | 6.24 |  |
| 21 | Peanut shell | 550 | KOH | Hierarchical | 1713 | 0.73 | 0.73 | 88 | 1.1 | 0.98 | 9.92 | 25 | 1 | 4.41 | [24] |
|  |  |  |  |  | 1893 | 0.79 | 0.78 | 89.7 | 0.8 | 0.79 | 8.71 | 25 | 1 | 4.22 |  |
|  |  |  |  |  | 1871 | 0.8 | 0.79 | 90.5 | 0.6 | 0.6 | 8.3 | 25 | 1 | 3.92 |  |
|  |  |  |  |  | 1713 | 0.73 | 0.73 | 88 | 1.1 | 0.98 | 9.92 | 0 | 1 | 7.25 |  |
|  |  |  |  |  | 1893 | 0.79 | 0.78 | 89.7 | 0.8 | 0.79 | 8.71 | 0 | 1 | 7.12 |  |
|  |  |  |  |  | 1871 | 0.8 | 0.79 | 90.5 | 0.6 | 0.6 | 8.3 | 0 | 1 | 6.79 |  |
| 22 | Pine nut shell | 500 | KOH | Microporous | 1486 | 0.64 |  | 66.2 | 2.6 | 0.1 | 22.6 | 25 | 1 | 5 | [25] |
| 23 | Macadamia nut shell | 400-700 | CO2 | Microporous | 469 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.07 | [26] |
|  |  |  |  |  | 489 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.3 |  |
|  |  |  |  |  | 606 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.4 |  |
|  |  |  |  |  | 425 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 2.8 |  |
|  |  |  |  |  | 514 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.25 |  |
|  |  |  |  |  | 605 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.45 |  |
|  |  |  |  |  | 441 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 2.99 |  |
|  |  |  |  |  | 512 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.37 |  |
|  |  |  |  |  | 573 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.48 |  |
|  |  |  |  |  | 434 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.01 |  |
|  |  |  |  |  | 524 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.42 |  |
|  |  |  |  |  | 633 |  |  | 57.5 | 5.95 | 0.33 | 36.2 | 25 | 1.01 | 3.73 |  |
| 24 | Agar | 500 | Zn(NO3)2 | Hierarchical | 671 | 0.43 |  | 86.73 | 0 | 2.72 | 10.55 | 25 | 1 | 2.3 | [27] |
|  |  |  |  |  | 886 | 0.57 |  | 87.7 | 0 | 2.28 | 10.02 | 25 | 1 | 2.6 |  |
|  |  |  |  |  | 1033 | 0.69 |  | 87.71 | 0 | 2.58 | 9.71 | 25 | 1 | 2.4 |  |
|  |  |  |  |  | 858 | 0.57 |  | 90.01 | 0 | 2.7 | 7.29 | 25 | 1 | 2.5 |  |
|  |  |  |  |  | 1142 | 0.85 |  | 92.5 | 0 | 0.85 | 6.65 | 25 | 1 | 2.5 |  |
|  |  |  |  |  | 1316 | 1.14 |  | 93.18 | 0 | 1.14 | 5.68 | 25 | 1 | 2.5 |  |
| 25 | Hazelnut shell | 500 | NaNH2 | Microporous | 502 | 0.22 |  | 85.21 | 5.87 | 2.74 | 6.18 | 25 | 1 | 2.24 | [28] |
|  |  |  |  |  | 1991 | 0.88 |  | 87.21 | 5.03 | 2.94 | 4.82 | 25 | 1 | 3.72 |  |
|  |  |  |  |  | 1833 | 0.8 |  | 86.24 | 5.31 | 3.21 | 5.24 | 25 | 1 | 3.39 |  |
|  |  |  |  |  | 1099 | 0.45 |  | 86.32 | 5.99 | 2.53 | 5.16 | 25 | 1 | 4.32 |  |
|  |  |  |  |  | 1821 | 0.79 |  | 86.74 | 5.87 | 2.75 | 4.64 | 25 | 1 | 3.5 |  |
|  |  |  |  |  | 2185 | 0.99 |  | 87.02 | 6.01 | 2.97 | 4 | 25 | 1 | 3.48 |  |
|  |  |  |  |  | 1343 | 0.55 |  | 87.65 | 5.24 | 1.98 | 5.13 | 25 | 1 | 3.94 |  |
|  |  |  |  |  | 2318 | 1.03 |  | 88.34 | 5.87 | 2.14 | 3.65 | 25 | 1 | 3.52 |  |
|  |  |  |  |  | 2321 | 1.11 |  | 88.21 | 5.21 | 2.3 | 4.28 | 25 | 1 | 3.38 |  |
| 26 | Walnut shell powder |  | KOH | Hierarchical | 1636 | 0.74 | 0.68 | 54 | 3.75 | 2.69 | 39.56 | 25 | 1 | 2.86 | [29] |
|  |  |  |  |  | 2354 | 1.26 | 0.97 | 75.38 | 1.3 | 0.86 | 22.46 | 25 | 1 | 3.08 |  |
|  |  |  |  |  | 759 | 0.44 | 0.33 | 51.21 | 1.96 | 4.45 | 42.38 | 25 | 1 | 2.32 |  |
|  |  |  |  |  | 1606 | 0.97 | 0.78 | 71.19 | 2.88 | 4.02 | 21.91 | 25 | 1 | 1.92 |  |
|  |  |  |  |  | 1741 | 0.86 | 0.8 | 64.43 | 3.21 | 2.2 | 30.16 | 25 | 1 | 2.74 |  |
|  |  |  |  |  | 1636 | 0.74 | 0.68 | 54 | 3.75 | 2.69 | 39.56 | 25 | 1 | 2.86 |  |
|  |  |  |  |  | 2251 | 1.21 | 1.03 | 70.44 | 1.62 | 0.94 | 27 | 25 | 1 | 2.54 |  |
|  |  |  |  |  | 3079 | 1.84 | 1.18 | 80.49 | 1.2 | 2.08 | 16.23 | 25 | 1 | 2.53 |  |
|  |  |  |  |  | 2354 | 1.26 | 0.97 | 75.38 | 1.3 | 0.86 | 22.46 | 25 | 1 | 3.04 |  |
|  |  |  |  |  | 2556 | 1.9 | 0.96 | 81.84 | 1.75 | 0.76 | 15.65 | 25 | 1 | 2.27 |  |
|  |  |  |  |  | 1000 | 0.68 | 0.53 | 51.67 | 1.75 | 1.57 | 45.01 | 25 | 1 | 2.37 |  |
|  |  |  |  |  | 759 | 0.44 | 0.33 | 51.21 | 1.96 | 4.45 | 42.38 | 0 | 1 | 3.3 |  |
|  |  |  |  |  | 1606 | 0.97 | 0.78 | 71.19 | 2.88 | 4.02 | 21.91 | 0 | 1 | 2.9 |  |
|  |  |  |  |  | 1741 | 0.86 | 0.8 | 64.43 | 3.21 | 2.2 | 30.16 | 0 | 1 | 4.73 |  |
|  |  |  |  |  | 1636 | 0.74 | 0.68 | 54 | 3.75 | 2.69 | 39.56 | 0 | 1 | 5 |  |
|  |  |  |  |  | 2251 | 1.21 | 1.03 | 70.44 | 1.62 | 0.94 | 27 | 0 | 1 | 4.2 |  |
|  |  |  |  |  | 3079 | 1.84 | 1.18 | 80.49 | 1.2 | 2.08 | 16.23 | 0 | 1 | 3.35 |  |
|  |  |  |  |  | 2354 | 1.26 | 0.97 | 75.38 | 1.3 | 0.86 | 22.46 | 0 | 1 | 5.13 |  |
|  |  |  |  |  | 2556 | 1.9 | 0.96 | 81.84 | 1.75 | 0.76 | 15.65 | 0 | 1 | 3.35 |  |
|  |  |  |  |  | 1000 | 0.68 | 0.53 | 51.67 | 1.75 | 1.57 | 45.01 | 0 | 1 | 2.57 |  |
| 27 | Walnut shell |  | KOH | Hierarchical | 1636 | 0.74 | 0.68 | 54 | 3.75 | 2.69 | 39.56 | 25 | 0.15 | 0.67 | [30] |
|  |  |  |  |  | 2354 | 1.26 | 0.97 | 75.38 | 1.3 | 0.86 | 22.46 | 25 | 0.15 | 0.64 |  |
|  |  |  |  |  | 1144 | 0.64 | 0.48 | 68.18 | 1.57 | 4.8 | 25.45 | 25 | 1 | 2.1 |  |
|  |  |  |  |  | 1813 | 1.05 | 0.7 | 80.95 | 0.79 | 1 | 17.26 | 25 | 1 | 2.14 |  |
|  |  |  |  |  | 273 | 0.19 | 0.13 | 46.52 | 1.55 | 9.32 | 42.61 | 25 | 1 | 1.78 |  |
|  |  |  |  |  | 481 | 0.27 | 0.24 | 52.01 | 1.92 | 8.75 | 37.32 | 25 | 1 | 1.83 |  |
|  |  |  |  |  | 1144 | 0.64 | 0.48 | 68.18 | 1.57 | 4.8 | 25.45 | 25 | 0.15 | 0.36 |  |
|  |  |  |  |  | 1813 | 1.05 | 0.7 | 80.95 | 0.79 | 1 | 17.26 | 25 | 0.15 | 0.38 |  |
|  |  |  |  |  | 273 | 0.19 | 0.13 | 46.52 | 1.55 | 9.32 | 42.61 | 25 | 0.15 | 0.69 |  |
|  |  |  |  |  | 481 | 0.27 | 0.24 | 52.01 | 1.92 | 8.75 | 37.32 | 25 | 0.15 | 0.67 |  |
| 28 | Oil residue | 500 | NaNH2 | Hierarchical | 660 | 0.42 | 0.33 | 57.89 | 2.71 | 4.31 | 35.09 | 25 | 1 | 2.04 | [31] |
|  |  |  |  |  | 846 | 0.94 | 0.4 | 56.5 | 2.52 | 4.59 | 36.39 | 25 | 1 | 2.11 |  |
|  |  |  |  |  | 1176 | 0.72 | 0.57 | 60.87 | 3.01 | 5.83 | 30.29 | 25 | 1 | 2.19 |  |
|  |  |  |  |  | 2113 | 1.24 | 0.94 | 61.07 | 1.98 | 6.9 | 30.05 | 25 | 1 | 3.51 |  |
|  |  |  |  |  | 1508 | 0.94 | 0.68 | 62.98 | 2.1 | 6.02 | 28.9 | 25 | 1 | 3.42 |  |
|  |  |  |  |  | 2148 | 1.32 | 0.94 | 64.49 | 1.7 | 5.57 | 28.24 | 25 | 1 | 2.98 |  |
| 29 | Glucose biomass | 80 | CO2 | Microporous | 748 | 0.47 | 0.27 | 83.84 | 0.04 | 1.1 | 15.02 | 25 | 1 | 2.55 | [32] |
|  |  |  |  |  | 697 | 0.46 | 0.25 | 75.15 | 0.05 | 6.5 | 18.3 | 25 | 1 | 2.92 |  |
|  |  |  |  |  | 581 | 0.35 | 0.21 | 67.78 | 1.14 | 11.48 | 19.5 | 25 | 1 | 3.03 |  |
| 30 | Shell of tea seed | 700 | KOH | Microporous | 1065 | 0.47 | 0.39 | 59.43 | 1.24 | 2.43 | 36.9 | 25 | 1 | 2.69 | [33] |
|  |  |  |  |  | 1188 | 0.52 | 0.44 | 66.21 | 0.94 | 3.41 | 29.44 | 25 | 1 | 2.75 |  |
|  |  |  |  |  | 1055 | 0.46 | 0.39 | 61.47 | 1.16 | 3.45 | 33.92 | 25 | 1 | 2.44 |  |
|  |  |  |  |  | 706 | 0.33 | 0.25 | 48.26 | 1.77 | 3.39 | 46.58 | 25 | 1 | 1.95 |  |
| 31 | Water chestnut shell | 500 |  | Hierarchical | 669 | 0.31 |  | 71.42 | 3.06 | 3.05 | 22.47 | 25 | 1 | 3.29 | [34] |
|  |  |  |  |  | 1450 | 0.61 |  | 73.24 | 2.99 | 3.26 | 20.51 | 25 | 1 | 3.63 |  |
|  |  |  |  |  | 1310 | 0.65 |  | 74.25 | 3.01 | 3.58 | 19.16 | 25 | 1 | 3.18 |  |
|  |  |  |  |  | 1036 | 0.44 |  | 76.21 | 3.01 | 2.73 | 18.05 | 25 | 1 | 4.06 |  |
|  |  |  |  |  | 2412 | 1.14 |  | 75.2 | 2.75 | 3.14 | 18.91 | 25 | 1 | 4.04 |  |
|  |  |  |  |  | 2596 | 1.42 |  | 73.58 | 2.8 | 3.35 | 20.27 | 25 | 1 | 3.59 |  |
|  |  |  |  |  | 1416 | 0.58 |  | 77.43 | 2.42 | 2.42 | 17.73 | 25 | 1 | 4.5 |  |
|  |  |  |  |  | 2615 | 1.38 |  | 76.52 | 2.53 | 2.68 | 18.27 | 25 | 1 | 3.6 |  |
|  |  |  |  |  | 2446 | 1.59 |  | 76.03 | 2.86 | 3.12 | 17.99 | 25 | 1 | 3.39 |  |
| 32 | Poplar catkins | 400 | ZnCl2 | Hierarchical | 1361.9 | 0.58 | 0.46 | 87.23 | 1.62 | 1.89 | 9.26 | 25 | 1 | 3.55 | [35] |
|  |  |  |  |  | 1005.4 | 0.41 | 0.34 | 87.42 | 1.32 | 2.37 | 8.89 | 25 | 1 | 3.75 |  |
|  |  |  |  |  | 1455.1 | 0.68 | 0.47 | 88.57 | 0.89 | 2.89 | 7.65 | 25 | 1 | 4.05 |  |
|  |  |  |  |  | 1248.7 | 0.5 | 0.41 | 89.74 | 0.78 | 2.16 | 7.32 | 25 | 1 | 2.62 |  |
|  |  |  |  |  | 1272.4 | 0.55 | 0.43 | 89.23 | 0.82 | 2.09 | 7.86 | 25 | 1 | 3.35 |  |
| 33 | Walnut shell | 500 | NaNH2 | Hierarchical | 419 | 0.25 | 0.19 | 54.24 | 3.37 | 3.79 | 38.6 | 25 | 1 | 1.93 | [36] |
|  |  |  |  |  | 589 | 0.34 | 0.27 | 63.53 | 4.38 | 7.24 | 24.85 | 25 | 1 | 2.53 |  |
|  |  |  |  |  | 802 | 0.47 | 0.37 | 57.6 | 3.45 | 1.52 | 37.43 | 25 | 1 | 1.96 |  |
|  |  |  |  |  | 516 | 0.28 | 0.2 | 52.55 | 3.35 | 3.52 | 40.58 | 25 | 1 | 1.7 |  |
|  |  |  |  |  | 1687 | 0.94 | 0.77 | 72.63 | 3.18 | 1.89 | 22.3 | 25 | 1 | 3.06 |  |
|  |  |  |  |  | 1721 | 0.92 | 0.75 | 61.53 | 1.45 | 2.54 | 34.48 | 25 | 1 | 2.15 |  |
|  |  |  |  |  | 419 | 0.25 | 0.19 | 54.24 | 3.37 | 3.79 | 38.6 | 0 | 1 | 2.6 |  |
|  |  |  |  |  | 589 | 0.34 | 0.27 | 63.53 | 4.38 | 7.24 | 24.85 | 0 | 1 | 4.17 |  |
|  |  |  |  |  | 802 | 0.47 | 0.37 | 57.6 | 3.45 | 1.52 | 37.43 | 0 | 1 | 3.88 |  |
|  |  |  |  |  | 516 | 0.28 | 0.2 | 52.55 | 3.35 | 3.52 | 40.58 | 0 | 1 | 2.67 |  |
|  |  |  |  |  | 1687 | 0.94 | 0.77 | 72.63 | 3.18 | 1.89 | 22.3 | 0 | 1 | 5.22 |  |
|  |  |  |  |  | 1721 | 0.92 | 0.75 | 61.53 | 1.45 | 2.54 | 34.48 | 0 | 1 | 3.17 |  |
| 34 | Glucose-d | 180 | KOH | Hierarchical | 821 | 0.42 |  | 65.54 | 2.14 | 12.17 | 20.15 | 25 | 1 | 3.99 | [37] |
|  |  |  |  |  | 1267 | 0.54 |  | 64.89 | 2.15 | 11.93 | 21.03 | 25 | 1 | 4.24 |  |
|  |  |  |  |  | 1398 | 0.6 |  | 63.54 | 2.16 | 11.67 | 22.63 | 25 | 1 | 4.02 |  |
|  |  |  |  |  | 1412 | 0.63 |  | 62.21 | 2.12 | 11.23 | 24.44 | 25 | 1 | 3.93 |  |
|  |  |  |  |  | 1734 | 0.78 |  | 75.01 | 1.41 | 9.24 | 14.34 | 25 | 1 | 4.26 |  |
|  |  |  |  |  | 1960 | 0.9 |  | 74.32 | 1.35 | 8.56 | 15.77 | 25 | 1 | 4.23 |  |
|  |  |  |  |  | 2167 | 0.96 |  | 72.68 | 1.37 | 7.23 | 18.72 | 25 | 1 | 4.21 |  |
|  |  |  |  |  | 2016 | 0.94 |  | 75.35 | 1.17 | 6.85 | 16.63 | 25 | 1 | 4.07 |  |
|  |  |  |  |  | 2394 | 1.13 |  | 81.51 | 0.89 | 6.94 | 10.66 | 25 | 1 | 3.92 |  |
|  |  |  |  |  | 2659 | 1.32 |  | 79.12 | 0.75 | 6.72 | 13.41 | 25 | 1 | 3.71 |  |
|  |  |  |  |  | 2655 | 1.4 |  | 77.05 | 0.85 | 6.43 | 15.67 | 25 | 1 | 3.51 |  |
|  |  |  |  |  | 2470 | 1.3 |  | 76.92 | 0.96 | 6.2 | 15.92 | 25 | 1 | 3.42 |  |
|  |  |  |  |  | 821 | 0.42 |  | 65.54 | 2.14 | 12.17 | 20.15 | 0 | 1 | 5.33 |  |
|  |  |  |  |  | 1267 | 0.54 |  | 64.89 | 2.15 | 11.93 | 21.03 | 0 | 1 | 6.23 |  |
|  |  |  |  |  | 1398 | 0.6 |  | 63.54 | 2.16 | 11.67 | 22.63 | 0 | 1 | 6.11 |  |
|  |  |  |  |  | 1412 | 0.63 |  | 62.21 | 2.12 | 11.23 | 24.44 | 0 | 1 | 5.9 |  |
|  |  |  |  |  | 1734 | 0.78 |  | 75.01 | 1.41 | 9.24 | 14.34 | 0 | 1 | 6.7 |  |
|  |  |  |  |  | 1960 | 0.9 |  | 74.32 | 1.35 | 8.56 | 15.77 | 0 | 1 | 6.14 |  |
|  |  |  |  |  | 2167 | 0.96 |  | 72.68 | 1.37 | 7.23 | 18.72 | 0 | 1 | 6.28 |  |
|  |  |  |  |  | 2016 | 0.94 |  | 75.35 | 1.17 | 6.85 | 16.63 | 0 | 1 | 6.11 |  |
|  |  |  |  |  | 2394 | 1.13 |  | 81.51 | 0.89 | 6.94 | 10.66 | 0 | 1 | 6.46 |  |
|  |  |  |  |  | 2659 | 1.32 |  | 79.12 | 0.75 | 6.72 | 13.41 | 0 | 1 | 5.73 |  |
|  |  |  |  |  | 2655 | 1.4 |  | 77.05 | 0.85 | 6.43 | 15.67 | 0 | 1 | 5.36 |  |
|  |  |  |  |  | 2470 | 1.3 |  | 76.92 | 0.96 | 6.2 | 15.92 | 0 | 1 | 5.24 |  |
| 35 | Palm kernel shell | 500 |  | Microporous | 195 | 0.11 | 0.08 | 90.23 | 0 | 1.77 | 7.76 | 25 | 1 | 1.43 | [38] |
|  |  |  |  |  | 852 | 0.38 | 0.31 | 85.9 | 0 | 3.03 | 10.87 | 25 | 1 | 4.39 |  |
|  |  |  |  |  | 1185 | 0.52 | 0.43 | 90.97 | 0 | 3.35 | 5.54 | 25 | 1 | 4.8 |  |
|  |  |  |  |  | 694 | 0.37 | 0.25 | 88.31 | 0 | 1.95 | 9.53 | 25 | 1 | 3.39 |  |
|  |  |  |  |  | 699 | 0.49 | 0.16 | 92.63 | 0 | 1.73 | 5.45 | 25 | 1 | 2.56 |  |
|  |  |  |  |  | 586 | 0.31 | 0.19 | 88.52 | 0 | 2.94 | 8.24 | 25 | 1 | 2.84 |  |
|  |  |  |  |  | 1700 | 0.89 | 0.56 | 86.45 | 0 | 3.3 | 9.97 | 25 | 1 | 5.29 |  |
| 36 | Lignin | 200 | KOH | Hierarchical | 3172 | 1.6 |  | 87.72 | 0 | 0 | 12.08 | 25 | 1 | 2.3 | [39] |
|  |  |  |  |  | 3020 | 1.89 |  | 80.03 | 0 | 0.62 | 19.34 | 25 | 1 | 2.2 |  |
|  |  |  |  |  | 3064 | 1.56 |  | 87.1 | 0 | 0.64 | 12.26 | 25 | 1 | 2.5 |  |
|  |  |  |  |  | 3021 | 1.58 |  | 89.55 | 0 | 1.1 | 9.35 | 25 | 1 | 2.6 |  |
|  |  |  |  |  | 2473 | 1.26 |  | 87.81 | 0 | 1.17 | 11.02 | 25 | 1 | 2.7 |  |
| 37 | Pineapple waste | 210 |  | Hierarchical | 124 |  |  | 84.82 | 1.56 | 1.3 | 12.32 | 25 | 1 | 1.16 | [40] |
|  |  |  |  |  | 224.1 |  |  | 86.06 | 1.55 | 1.69 | 10.7 | 25 | 1 | 1.18 |  |
|  |  |  |  |  | 422.8 |  |  | 80.01 | 1.16 | 1.52 | 17.31 | 25 | 1 | 2.22 |  |
|  |  |  |  |  | 302.7 |  |  | 81.12 | 0.75 | 1.3 | 16.83 | 25 | 1 | 1.59 |  |
|  |  |  |  |  | 328.2 |  |  | 84.98 | 0.2 | 1.59 | 13.23 | 25 | 1 | 1.33 |  |
|  |  |  |  |  | 644.9 |  |  | 73.52 | 1.09 | 1.49 | 23.9 | 25 | 1 | 3.16 |  |
|  |  |  |  |  | 186 |  |  | 85.04 | 0.48 | 1.12 | 13.36 | 25 | 1 | 1.35 |  |
|  |  |  |  |  | 397.3 |  |  | 83.29 | 0.17 | 1.58 | 14.96 | 25 | 1 | 1.59 |  |
|  |  |  |  |  | 1076.3 |  |  | 86.31 | 0.14 | 0.33 | 13.22 | 25 | 1 | 4.25 |  |
| 38 | Glucose | 180 | KOH | Hierarchical | 1082 | 0.58 | 0.44 | 77.91 | 0 | 9.44 | 12.65 | 25 | 1 | 3.78 | [41] |
|  |  |  |  |  | 1793 | 0.87 | 0.73 | 81.12 | 0 | 8.02 | 10.86 | 25 | 1 | 5.01 |  |
|  |  |  |  |  | 2328 | 1.11 | 0.94 | 84.91 | 0 | 5.05 | 10.04 | 25 | 1 | 4.32 |  |
|  |  |  |  |  | 2958 | 1.61 | 1.16 | 92.8 | 0 | 2.73 | 4.47 | 25 | 1 | 3.36 |  |
|  |  |  |  |  | 1082 | 0.58 | 0.44 | 77.91 | 0 | 9.44 | 12.65 | 25 | 0.15 | 1.29 |  |
|  |  |  |  |  | 1793 | 0.87 | 0.73 | 81.12 | 0 | 8.02 | 10.86 | 25 | 0.15 | 1.38 |  |
|  |  |  |  |  | 2328 | 1.11 | 0.94 | 84.91 | 0 | 5.05 | 10.04 | 25 | 0.15 | 0.93 |  |
|  |  |  |  |  | 2958 | 1.61 | 1.16 | 92.8 | 0 | 2.73 | 4.47 | 25 | 0.15 | 0.65 |  |
|  |  |  |  |  | 1082 | 0.58 | 0.44 | 77.91 | 0 | 9.44 | 12.65 | 0 | 1 | 5.36 |  |
|  |  |  |  |  | 1793 | 0.87 | 0.73 | 81.12 | 0 | 8.02 | 10.86 | 0 | 1 | 7.6 |  |
|  |  |  |  |  | 2328 | 1.11 | 0.94 | 84.91 | 0 | 5.05 | 10.04 | 0 | 1 | 7.18 |  |
|  |  |  |  |  | 2958 | 1.61 | 1.16 | 92.8 | 0 | 2.73 | 4.47 | 0 | 1 | 6.24 |  |
| 39 | Glucose-d |  | KOH | Microporous | 1210 | 0.69 |  | 74.3 | 0 | 9.8 | 15.9 | 25 | 1 | 4.18 | [42] |
|  |  |  |  |  | 1780 | 1.35 |  | 82.5 | 0 | 6.94 | 10.56 | 25 | 1 | 4.66 |  |
|  |  |  |  |  | 2136 | 1.43 |  | 80.8 | 0 | 6.84 | 12.36 | 25 | 1 | 3.89 |  |
|  |  |  |  |  | 3247 | 3.09 |  | 86.9 | 0 | 2.07 | 11.03 | 25 | 1 | 4.95 |  |
|  |  |  |  |  | 1210 | 0.69 |  | 74.3 | 0 | 9.8 | 15.9 | 0 | 1 | 6.11 |  |
|  |  |  |  |  | 1780 | 1.35 |  | 82.5 | 0 | 6.94 | 10.56 | 0 | 1 | 7.77 |  |
|  |  |  |  |  | 2136 | 1.43 |  | 80.8 | 0 | 6.84 | 12.36 | 0 | 1 | 7.43 |  |
|  |  |  |  |  | 3247 | 3.09 |  | 86.9 | 0 | 2.07 | 11.03 | 0 | 1 | 8.07 |  |
| 40 | Sugarcane bagasse |  |  | Microporous | 32 | 0.02 |  | 83.16 | 1.74 | 3.81 | 11.29 | 25 | 1 | 1.94 | [43] |
|  |  |  |  |  | 851 | 0.44 |  | 87 | 0.97 | 0.83 | 11.2 | 25 | 1 | 4.52 |  |
|  |  |  |  |  | 927 | 0.48 |  | 83.26 | 1.17 | 1.76 | 13.81 | 25 | 1 | 4.6 |  |
|  |  |  |  |  | 1113 | 0.57 |  | 83.59 | 1.18 | 1.98 | 13.25 | 25 | 1 | 4.8 |  |
|  |  |  |  |  | 1024 | 0.53 |  | 83.02 | 1.16 | 1.98 | 13.84 | 25 | 1 | 4.76 |  |
|  |  |  |  |  | 945 | 0.49 |  | 84.19 | 1.12 | 1.99 | 12.7 | 25 | 1 | 4.71 |  |
| 41 | Lotus stalks | 500 | NaNH2 | Hierarchical | 848 | 0.38 |  | 67.03 | 2.34 | 3.77 | 26.86 | 25 | 1 | 3.39 | [44] |
|  |  |  |  |  | 1164 | 0.54 |  | 68.32 | 2.55 | 4.01 | 25.12 | 25 | 1 | 3.67 |  |
|  |  |  |  |  | 1087 | 0.52 |  | 67.65 | 2.25 | 4.5 | 25.6 | 25 | 1 | 3.22 |  |
|  |  |  |  |  | 1105 | 0.49 |  | 70.25 | 2.12 | 3.21 | 24.42 | 25 | 1 | 3.69 |  |
|  |  |  |  |  | 2053 | 0.97 |  | 71.37 | 2.04 | 3.64 | 22.95 | 25 | 1 | 3.47 |  |
|  |  |  |  |  | 1921 | 1.04 |  | 70.98 | 2.06 | 4.03 | 22.93 | 25 | 1 | 3.12 |  |
|  |  |  |  |  | 1113 | 0.48 |  | 73.56 | 2.09 | 2.61 | 21.74 | 25 | 1 | 3.88 |  |
|  |  |  |  |  | 2264 | 1.34 |  | 74.32 | 1.97 | 3.08 | 20.63 | 25 | 1 | 3.51 |  |
|  |  |  |  |  | 1824 | 1.03 |  | 74.98 | 1.88 | 3.45 | 19.69 | 25 | 1 | 3.45 |  |
| 42 | Phenolic resins | 500 | NaNH2 | Microporous | 735 | 0.31 |  | 77.7 | 2.58 | 2.72 | 17 | 25 | 1 | 3.32 | [45] |
|  |  |  |  |  | 936 | 0.39 |  | 78.36 | 2.29 | 4.56 | 14.79 | 25 | 1 | 4.12 |  |
|  |  |  |  |  | 1115 | 0.46 |  | 79.36 | 2.43 | 5.36 | 12.85 | 25 | 1 | 4.14 |  |
|  |  |  |  |  | 1003 | 0.41 |  | 79.11 | 2.16 | 6.05 | 12.68 | 25 | 1 | 3.83 |  |
|  |  |  |  |  | 787 | 0.33 |  | 80.6 | 2.42 | 1.56 | 15.42 | 25 | 1 | 3.86 |  |
|  |  |  |  |  | 1088 | 0.45 |  | 79.32 | 2.36 | 3.9 | 14.42 | 25 | 1 | 4.06 |  |
|  |  |  |  |  | 1432 | 0.59 |  | 78.62 | 1.76 | 4.25 | 15.37 | 25 | 1 | 4.64 |  |
|  |  |  |  |  | 1569 | 0.64 |  | 77.65 | 2.24 | 5.94 | 14.17 | 25 | 1 | 4.4 |  |
|  |  |  |  |  | 932 | 0.39 |  | 85.36 | 1.95 | 1.39 | 11.3 | 25 | 1 | 4.03 |  |
|  |  |  |  |  | 1288 | 0.54 |  | 83.69 | 1.7 | 3.85 | 10.76 | 25 | 1 | 4.61 |  |
|  |  |  |  |  | 1924 | 0.79 |  | 81.34 | 1.64 | 4.09 | 12.93 | 25 | 1 | 4.57 |  |
|  |  |  |  |  | 2155 | 0.94 |  | 76.96 | 1.29 | 5.74 | 16.01 | 25 | 1 | 4.38 |  |
| 43 | Coconut shell | 500 | K2CO3 | Hierarchical | 947 | 0.35 |  | 86.59 | 0.94 | 2.76 | 9.71 | 25 | 1 | 3.45 | [46] |
|  |  |  |  |  | 1082 | 0.39 |  | 87.48 | 0.88 | 2.74 | 8.9 | 25 | 1 | 3.71 |  |
|  |  |  |  |  | 1324 | 0.51 |  | 91.35 | 0.82 | 1.52 | 6.31 | 25 | 1 | 3.49 |  |
|  |  |  |  |  | 1199 | 0.47 |  | 91.08 | 0.52 | 1.42 | 6.98 | 25 | 1 | 3.07 |  |
|  |  |  |  |  | 1354 | 0.58 |  | 88.71 | 0.55 | 1.34 | 9.4 | 25 | 1 | 3.03 |  |
|  |  |  |  |  | 1329 | 0.56 |  | 91.35 | 0.56 | 1.13 | 6.96 | 25 | 1 | 2.86 |  |
|  |  |  |  |  | 1430 | 0.65 |  | 93.24 | 0.65 | 0.86 | 5.25 | 25 | 1 | 2.78 |  |
| 44 | Argan hard shell | 700 | KOH and NaOH | Hierarchical | 2251 | 1.04 | 0.93 | 85.08 | 0 | 9.49 | 5.43 | 25 | 1 | 5.51 | [47] |
|  |  |  |  |  | 1890 | 0.87 | 0.8 | 82.68 | 0 | 13.9 | 3.42 | 25 | 1 | 5.63 |  |
|  |  |  |  |  | 1463 | 0.74 | 0.58 | 67.74 | 0 | 9.07 | 23.19 | 25 | 1 | 3.64 |  |
|  |  |  |  |  | 1827 | 0.96 | 0.73 | 82.14 | 0 | 12.61 | 5.25 | 25 | 1 | 3.73 |  |
| 45 | Olive stone, coffee, almond shell, grape seed |  | CO2 | Microporous | 514 | 0.21 |  | 92.2 | 0 | 0.4 | 7.4 | 25 | 0.15 | 0.88 | [48] |
|  |  |  |  |  | 1248 | 0.44 |  | 88 | 0 | 0.7 | 11.3 | 25 | 0.15 | 0.99 |  |
|  |  |  |  |  | 534 | 0.25 |  | 83.7 | 0 | 4.1 | 12.2 | 25 | 0.15 | 1.11 |  |
|  |  |  |  |  | 847 | 0.34 |  | 81.9 | 0 | 1.3 | 16.8 | 25 | 0.15 | 0.98 |  |
|  |  |  |  |  | 535 | 0.23 |  | 85.3 | 0 | 1.8 | 12.9 | 25 | 0.15 | 0.91 |  |
|  |  |  |  |  | 362 | 0.27 |  | 90 | 0 | 2.2 | 7.8 | 25 | 0.15 | 0.91 |  |
|  |  |  |  |  | 840 | 0.34 |  | 82.6 | 0 | 2.1 | 15.3 | 25 | 0.15 | 0.75 |  |
| 46 | Black gram | 300 | KOH | Microporous | 956 | 0.48 | 0.31 | 76.95 | 2.39 | 4.82 | 15.84 | 25 | 1 | 3.34 | [49] |
|  |  |  |  |  | 1258 | 0.61 | 0.4 | 83.63 | 2.9 | 4.21 | 9.26 | 25 | 1 | 3.46 |  |
|  |  |  |  |  | 1697 | 0.82 | 0.37 | 84.08 | 2.06 | 3.86 | 10 | 25 | 1 | 3.46 |  |
|  |  |  |  |  | 1987 | 1.02 | 0.26 | 89.43 | 1.41 | 1.78 | 7.38 | 25 | 1 | 2.76 |  |
|  |  |  |  |  | 990 | 0.42 | 0.31 | 79.99 | 2.9 | 4.76 | 12.35 | 25 | 1 | 3.25 |  |
|  |  |  |  |  | 1428 | 0.65 | 0.29 | 78.36 | 2.58 | 4.38 | 14.68 | 25 | 1 | 3.06 |  |
|  |  |  |  |  | 1675 | 0.96 | 0.06 | 75.76 | 2.51 | 3.67 | 18.06 | 25 | 1 | 2.28 |  |
|  |  |  |  |  | 2086 | 1.08 | 0.16 | 91.38 | 1.06 | 2.52 | 5.04 | 25 | 1 | 2.59 |  |
|  |  |  |  |  | 1216 | 0.53 | 0.35 | 78.46 | 2.21 | 5.34 | 13.99 | 25 | 1 | 3.16 |  |
|  |  |  |  |  | 1446 | 0.63 | 0.37 | 81.6 | 2.41 | 4.15 | 11.84 | 25 | 1 | 3.21 |  |
|  |  |  |  |  | 1952 | 1.11 | 0.04 | 71.34 | 3.4 | 3.15 | 22.11 | 25 | 1 | 2.14 |  |
|  |  |  |  |  | 2305 | 1.23 | 0.13 | 79.17 | 2.13 | 1.81 | 16.89 | 25 | 1 | 2.34 |  |
|  |  |  |  |  | 956 | 0.48 | 0.31 | 76.95 | 2.39 | 4.82 | 15.84 | 0 | 1 | 4.61 |  |
|  |  |  |  |  | 1258 | 0.61 | 0.4 | 83.63 | 2.9 | 4.21 | 9.26 | 0 | 1 | 5.3 |  |
|  |  |  |  |  | 1697 | 0.82 | 0.37 | 84.08 | 2.06 | 3.86 | 10 | 0 | 1 | 5.25 |  |
|  |  |  |  |  | 1987 | 1.02 | 0.26 | 89.43 | 1.41 | 1.78 | 7.38 | 0 | 1 | 5.1 |  |
|  |  |  |  |  | 990 | 0.42 | 0.31 | 79.99 | 2.9 | 4.76 | 12.35 | 0 | 1 | 4.65 |  |
|  |  |  |  |  | 1428 | 0.65 | 0.29 | 78.36 | 2.58 | 4.38 | 14.68 | 0 | 1 | 4.97 |  |
|  |  |  |  |  | 1675 | 0.96 | 0.06 | 75.76 | 2.51 | 3.67 | 18.06 | 0 | 1 | 3.9 |  |
|  |  |  |  |  | 2086 | 1.08 | 0.16 | 91.38 | 1.06 | 2.52 | 5.04 | 0 | 1 | 4.69 |  |
|  |  |  |  |  | 1216 | 0.53 | 0.35 | 78.46 | 2.21 | 5.34 | 13.99 | 0 | 1 | 4.82 |  |
|  |  |  |  |  | 1446 | 0.63 | 0.37 | 81.6 | 2.41 | 4.15 | 11.84 | 0 | 1 | 5.15 |  |
|  |  |  |  |  | 1952 | 1.11 | 0.04 | 71.34 | 3.4 | 3.15 | 22.11 | 0 | 1 | 3.73 |  |
|  |  |  |  |  | 2305 | 1.23 | 0.13 | 79.17 | 2.13 | 1.81 | 16.89 | 0 | 1 | 4.79 |  |
| 47 | Glucose-d | 180 | K2CO3 | Hierarchical | 933 | 0.45 |  | 66.51 | 2.33 | 12.27 | 18.89 | 25 | 1 | 3.43 | [50] |
|  |  |  |  |  | 1005 | 0.46 |  | 65.31 | 2.38 | 12.21 | 20.1 | 25 | 1 | 3.46 |  |
|  |  |  |  |  | 1170 | 0.53 |  | 63.67 | 2.42 | 11.81 | 22.1 | 25 | 1 | 3.74 |  |
|  |  |  |  |  | 1754 | 0.83 |  | 69.83 | 2.14 | 10.51 | 17.52 | 25 | 1 | 3.69 |  |
|  |  |  |  |  | 1699 | 0.89 |  | 70.32 | 1.98 | 9.54 | 18.16 | 25 | 1 | 3.65 |  |
|  |  |  |  |  | 1824 | 0.92 |  | 71.66 | 1.97 | 7.74 | 18.63 | 25 | 1 | 3.92 |  |
|  |  |  |  |  | 2572 | 1.43 |  | 77.7 | 1.56 | 6.57 | 14.17 | 25 | 1 | 3.75 |  |
|  |  |  |  |  | 2510 | 1.54 |  | 80.32 | 1.73 | 5.03 | 12.92 | 25 | 1 | 3.56 |  |
|  |  |  |  |  | 2827 | 1.55 |  | 84.24 | 1.65 | 4.69 | 9.42 | 25 | 1 | 3.61 |  |
|  |  |  |  |  | 1020 | 0.52 |  | 73.65 | 2.15 | 0.32 | 23.88 | 25 | 1 | 3.66 |  |
|  |  |  |  |  | 933 | 0.45 |  | 66.51 | 2.33 | 12.27 | 18.89 | 0 | 1 | 4.8 |  |
|  |  |  |  |  | 1005 | 0.46 |  | 65.31 | 2.38 | 12.21 | 20.1 | 0 | 1 | 4.84 |  |
|  |  |  |  |  | 1170 | 0.53 |  | 63.67 | 2.42 | 11.81 | 22.1 | 0 | 1 | 5.32 |  |
|  |  |  |  |  | 1754 | 0.83 |  | 69.83 | 2.14 | 10.51 | 17.52 | 0 | 1 | 5.45 |  |
|  |  |  |  |  | 1699 | 0.89 |  | 70.32 | 1.98 | 9.54 | 18.16 | 0 | 1 | 5.87 |  |
|  |  |  |  |  | 1824 | 0.92 |  | 71.66 | 1.97 | 7.74 | 18.63 | 0 | 1 | 6.23 |  |
|  |  |  |  |  | 2572 | 1.43 |  | 77.7 | 1.56 | 6.57 | 14.17 | 0 | 1 | 6.23 |  |
|  |  |  |  |  | 2510 | 1.54 |  | 80.32 | 1.73 | 5.03 | 12.92 | 0 | 1 | 6.16 |  |
|  |  |  |  |  | 2827 | 1.55 |  | 84.24 | 1.65 | 4.69 | 9.42 | 0 | 1 | 6.05 |  |
|  |  |  |  |  | 1020 | 0.52 |  | 73.65 | 2.15 | 0.32 | 23.88 | 0 | 1 | 5.74 |  |
| 48 | Lignin | 300 | KOH | Hierarchical | 1788 | 0.91 | 0.49 | 40.4 | 0 | 5.6 | 54 | 25 | 1 | 4.8 | [51] |
|  |  |  |  |  | 2957 | 1.79 | 0.56 | 59.5 | 0 | 2.5 | 38 | 25 | 1 | 4.4 |  |
|  |  |  |  |  | 1075 | 0.75 | 0.21 | 64 | 0 | 2.2 | 33.8 | 25 | 1 | 4 |  |
|  |  |  |  |  | 1788 | 0.91 | 0.49 | 40.4 | 0 | 5.6 | 54 | 0 | 1 | 8.2 |  |
|  |  |  |  |  | 2957 | 1.79 | 0.56 | 59.5 | 0 | 2.5 | 38 | 0 | 1 | 7.6 |  |
|  |  |  |  |  | 1075 | 0.75 | 0.21 | 64 | 0 | 2.2 | 33.8 | 0 | 1 | 6.5 |  |
| 49 | Canes biomass |  |  | Hierarchical | 18 | 0.02 |  | 80.03 | 0 | 13.53 | 5.76 | 25 | 1 | 1.5 | [52] |
|  |  |  |  |  | 982 | 0.62 |  | 79.26 | 0 | 8.12 | 11.89 | 25 | 1 | 2.2 |  |
|  |  |  |  |  | 582 | 0.29 |  | 74.73 | 0 | 15.88 | 7.28 | 25 | 1 | 2.1 |  |
|  |  |  |  |  | 18 | 0.02 |  | 80.03 | 0 | 13.53 | 5.76 | 0 | 1 | 1.7 |  |
|  |  |  |  |  | 982 | 0.62 |  | 79.26 | 0 | 8.12 | 11.89 | 0 | 1 | 4.8 |  |
|  |  |  |  |  | 582 | 0.29 |  | 74.73 | 0 | 15.88 | 7.28 | 0 | 1 | 3 |  |
| 50 | Pigskin |  |  | Hierarchical | 1165 | 1.03 |  | 64.7 | 1.5 | 10.4 | 23.25 | 25 | 1 | 4.4 | [53] |
|  |  |  |  |  | 2693 | 1.68 |  | 84.8 | 0.5 | 6.2 | 8.21 | 25 | 1 | 3.1 |  |
|  |  |  |  |  | 2731 | 1.89 |  | 86.8 | 1.8 | 2.6 | 7.9 | 25 | 1 | 2.5 |  |
|  |  |  |  |  | 2799 | 1.91 |  | 91.9 | 1.2 | 1.6 | 4.45 | 25 | 1 | 2.2 |  |
|  |  |  |  |  | 1165 | 1.03 |  | 64.7 | 1.5 | 10.4 | 23.25 | 0 | 1 | 5.3 |  |
|  |  |  |  |  | 2693 | 1.68 |  | 84.8 | 0.5 | 6.2 | 8.21 | 0 | 1 | 4.7 |  |
|  |  |  |  |  | 2731 | 1.89 |  | 86.8 | 1.8 | 2.6 | 7.9 | 0 | 1 | 4.1 |  |
|  |  |  |  |  | 2799 | 1.91 |  | 91.9 | 1.2 | 1.6 | 4.45 | 0 | 1 | 4 |  |
| 51 | Chitosan | 550 | KOH | Microporous | 667 | 0.29 | 0.28 | 63.3 | 2.4 | 6.5 | 27.8 | 25 | 1 | 3.74 | [54] |
|  |  |  |  |  | 716 | 0.32 | 0.31 | 61.5 | 2.5 | 6.6 | 29.4 | 25 | 1 | 4.04 |  |
|  |  |  |  |  | 718 | 0.33 | 0.31 | 59.1 | 2.3 | 6.8 | 31.8 | 25 | 1 | 4.17 |  |
|  |  |  |  |  | 907 | 0.4 | 0.39 | 57.9 | 2.6 | 6.7 | 32.8 | 25 | 1 | 4.26 |  |
|  |  |  |  |  | 667 | 0.29 | 0.28 | 63.3 | 2.4 | 6.5 | 27.8 | 25 | 0.15 | 1.46 |  |
|  |  |  |  |  | 716 | 0.32 | 0.31 | 61.5 | 2.5 | 6.6 | 29.4 | 25 | 0.15 | 1.57 |  |
|  |  |  |  |  | 718 | 0.33 | 0.31 | 59.1 | 2.3 | 6.8 | 31.8 | 25 | 0.15 | 1.86 |  |
|  |  |  |  |  | 907 | 0.4 | 0.39 | 57.9 | 2.6 | 6.7 | 32.8 | 25 | 0.15 | 1.77 |  |
| 52 | Rotten strawberries | 180 | KOH | Hierarchical | 935 | 0.42 |  | 72.21 | 2.55 | 3.68 | 21.56 | 25 | 1 | 3.63 | [55] |
|  |  |  |  |  | 1441 | 0.6 |  | 68.99 | 2.21 | 5.16 | 23.64 | 25 | 1 | 4.04 |  |
|  |  |  |  |  | 1117 | 0.52 |  | 78.02 | 2.44 | 5.38 | 14.16 | 25 | 1 | 4.49 |  |
|  |  |  |  |  | 1482 | 0.64 |  | 70.16 | 3.06 | 5.06 | 21.72 | 25 | 1 | 3.87 |  |
|  |  |  |  |  | 1408 | 0.67 |  | 76.23 | 2.39 | 3.81 | 17.57 | 25 | 1 | 3.73 |  |
|  |  |  |  |  | 1577 | 0.68 |  | 79.18 | 2.11 | 2.6 | 16.11 | 25 | 1 | 3.99 |  |
| 53 | Lignin |  | KOH | Hierarchical | 2922 | 1.36 | 1.22 | 84.6 | 0 | 5.6 | 7.2 | 25 | 1 | 5.12 | [56] |
|  |  |  |  |  | 2779 | 1.39 | 1.1 | 79.1 | 0 | 7.1 | 11.8 | 25 | 1 | 5.48 |  |
|  |  |  |  |  | 1631 | 0.83 | 0.6 | 76.3 | 0 | 5.9 | 17.1 | 25 | 1 | 4.23 |  |
| 54 | Soya chunks | 180 | NaOH | Microporous | 607 |  |  | 80.2 | 0 | 4.3 | 15.5 | 25 | 1 | 2.7 | [57] |
|  |  |  |  |  | 1072 |  |  | 84 | 0 | 5.3 | 10.7 | 25 | 1 | 3.2 |  |
| 55 | Arundo donax |  | ZnCl2 | Hierarchical | 1863 | 1 |  | 75 | 0 | 5.4 | 19.6 | 25 | 1 | 2.1 | [58] |
|  |  |  |  |  | 1340 | 0.68 |  | 81 | 0 | 4.1 | 14.9 | 25 | 1 | 1.7 |  |
|  |  |  |  |  | 1420 | 0.76 |  | 82 | 0 | 3.5 | 14.5 | 25 | 1 | 2 |  |
| 56 | Coca cola |  |  | Hierarchical | 1082 | 0.43 |  | 69.6 | 0 | 3.3 | 13.8 | 25 | 1.01 | 3.2 | [59] |
|  |  |  |  |  | 1994 | 0.87 |  | 73.1 | 0 | 4.2 | 10.3 | 25 | 1.01 | 3.08 |  |
|  |  |  |  |  | 1405 | 0.8 |  | 74 | 0 | 3.5 | 12.5 | 25 | 1.01 | 5.22 |  |
| 57 | Waste wool | 300 | KOH | Hierarchical | 447 | 0.22 | 0.18 | 71.9 | 1.37 | 11.25 | 15.48 | 25 | 1 | 1.48 | [60] |
|  |  |  |  |  | 1010 | 0.57 | 0.37 | 70.73 | 1.64 | 4.57 | 23.06 | 25 | 1 | 2.33 |  |
|  |  |  |  |  | 1352 | 0.78 | 0.54 | 69.65 | 1.42 | 4.14 | 24.79 | 25 | 1 | 2.78 |  |
|  |  |  |  |  | 1420 | 0.86 | 0.52 | 67.47 | 1.68 | 3.7 | 27.15 | 25 | 1 | 2.35 |  |
| 58 | Coconut shell | 500 | KOH | Microporous | 1023 | 0.38 |  | 84.2 | 1.52 | 1.35 | 12.93 | 25 | 1 | 4.1 | [61] |
|  |  |  |  |  | 1383 | 0.56 |  | 83.3 | 1.32 | 1.08 | 14.3 | 25 | 1 | 4 |  |
|  |  |  |  |  | 1604 | 0.65 |  | 84.2 | 1.53 | 0.81 | 13.46 | 25 | 1 | 4.3 |  |
|  |  |  |  |  | 1178 | 0.49 |  | 82 | 1.34 | 1.23 | 15.43 | 25 | 1 | 4.1 |  |
|  |  |  |  |  | 1535 | 0.6 |  | 81.3 | 1.22 | 0.91 | 16.57 | 25 | 1 | 4.8 |  |
|  |  |  |  |  | 1687 | 0.67 |  | 83 | 1.29 | 0.7 | 15.01 | 25 | 1 | 4.3 |  |
|  |  |  |  |  | 1550 | 0.62 |  | 84.2 | 1.03 | 0.86 | 13.91 | 25 | 1 | 4.1 |  |
|  |  |  |  |  | 1596 | 0.64 |  | 86.3 | 0.92 | 0.73 | 12.05 | 25 | 1 | 4.7 |  |
|  |  |  |  |  | 1937 | 0.78 |  | 86.5 | 0.84 | 0.61 | 12.05 | 25 | 1 | 4.44 |  |
|  |  |  |  |  | 1513 | 0.58 |  | 80.8 | 2.4 | 0.23 | 16.57 | 25 | 1 | 3.7 |  |
|  |  |  |  |  | 1012 | 0.44 |  | 75.5 | 0.95 | 8.01 | 15.54 | 25 | 1 | 3 |  |
| 59 | Banana peel | 800 | CO2 | Hierarchical | 1426.1 | 0.83 | 0.56 | 43.5 | 2.2 | 4.2 | 50.1 | 25 | 1 | 2.7 | [62] |
|  |  |  |  |  | 764 |  |  | 62.51 | 0 | 5 | 32.49 | 30 | 1 | 1.90 |  |
| 60 | Black locust | 650 | KOH | Hierarchical | 2511 | 1.35 | 1.16 | 76.38 | 1.48 | 7.21 | 0 | 25 | 1 | 5.05 | [63] |
|  |  |  |  |  | 2511 | 1.35 | 1.16 | 76.38 | 1.48 | 7.21 | 0 | 0 | 1 | 7.19 |  |
|  |  |  |  |  | 2511 | 1.35 | 1.16 | 76.38 | 1.48 | 7.21 | 0 | 25 | 0.15 | 1.59 |  |
|  |  |  |  |  | 2511 | 1.35 | 1.16 | 76.38 | 1.48 | 7.21 | 0 | 0 | 0.15 | 3.26 |  |
| 61 | Bark stem | 170 | KOH | Hierarchical | 1393 | 0.63 | 0.49 | 87.48 | 0 | 1.61 | 10.91 | 25 | 1 | 3.92 | [64] |
|  |  |  |  |  | 1759 | 0.92 | 0.6 | 89.48 | 0 | 1.43 | 9.09 | 25 | 1 | 4.45 |  |
|  |  |  |  |  | 1229 | 0.89 | 0.15 | 92.59 | 0 | 0.99 | 6.42 | 25 | 1 | 3.76 |  |
| 62 | Coconut shell | 500 | KOH | Hierarchical | 879 | 0.38 |  | 64.2 | 4.02 | 6.16 | 25.62 | 25 | 1 | 3.68 | [65] |
|  |  |  |  |  | 1135 | 0.62 |  | 70.5 | 3.38 | 4.83 | 21.29 | 25 | 1 | 4.04 |  |
|  |  |  |  |  | 1850 | 0.87 |  | 69.8 | 3 | 4.31 | 22.89 | 25 | 1 | 4.16 |  |
|  |  |  |  |  | 1562 | 0.75 |  | 69 | 2.69 | 3.84 | 24.47 | 25 | 1 | 3.79 |  |
|  |  |  |  |  | 1483 | 0.66 |  | 70 | 2.67 | 4.56 | 22.77 | 25 | 1 | 4.26 |  |
|  |  |  |  |  | 1487 | 0.79 |  | 71.2 | 2.45 | 3.59 | 22.76 | 25 | 1 | 4.22 |  |
|  |  |  |  |  | 2322 | 1.06 |  | 74.1 | 2.8 | 3.19 | 19.91 | 25 | 1 | 4.1 |  |
|  |  |  |  |  | 2521 | 1.34 |  | 75.8 | 2.48 | 2.4 | 19.32 | 25 | 1 | 3.72 |  |
|  |  |  |  |  | 2349 | 0.99 |  | 77.3 | 2.03 | 2.22 | 18.45 | 25 | 1 | 4.22 |  |
|  |  |  |  |  | 1967 | 0.94 |  | 79.2 | 2.22 | 1.81 | 16.77 | 25 | 1 | 4.09 |  |
|  |  |  |  |  | 2690 | 1.19 |  | 78.3 | 2.46 | 1.7 | 17.54 | 25 | 1 | 3.96 |  |
|  |  |  |  |  | 2599 | 1.33 |  | 80.7 | 2.11 | 1.21 | 15.98 | 25 | 1 | 3.44 |  |
| 63 | Fallen leaves | 600 | KOH | Hierarchical | 1210 | 0.48 | 0.39 | 78.6 | 0 | 1.7 | 17.6 | 25 | 1 | 3.39 | [66] |
|  |  |  |  |  | 1360 | 0.51 | 0.4 | 81.3 | 0 | 1 | 15.3 | 25 | 1 | 4.09 |  |
|  |  |  |  |  | 1600 | 0.65 | 0.54 | 84.4 | 0 | 1.3 | 12.6 | 25 | 1 | 4.41 |  |
|  |  |  |  |  | 1630 | 0.66 | 0.56 | 85.5 | 0 | 2.5 | 12 | 25 | 1 | 4.2 |  |
|  |  |  |  |  | 2230 | 1.03 | 0.89 | 86.5 | 0 | 0.4 | 11.9 | 25 | 1 | 3.93 |  |
|  |  |  |  |  | 1950 | 0.88 | 0.72 | 84.8 | 0 | 0.4 | 11.9 | 25 | 1 | 4.23 |  |
|  |  |  |  |  | 1210 | 0.48 | 0.39 | 78.6 | 0 | 1.7 | 17.6 | 25 | 0.15 | 1.2 |  |
|  |  |  |  |  | 1360 | 0.51 | 0.4 | 81.3 | 0 | 1 | 15.3 | 25 | 0.15 | 1.55 |  |
|  |  |  |  |  | 1600 | 0.65 | 0.54 | 84.4 | 0 | 1.3 | 12.6 | 25 | 0.15 | 1.41 |  |
|  |  |  |  |  | 1630 | 0.66 | 0.56 | 85.5 | 0 | 2.5 | 12 | 25 | 0.15 | 1.14 |  |
|  |  |  |  |  | 2230 | 1.03 | 0.89 | 86.5 | 0 | 0.4 | 11.9 | 25 | 0.15 | 0.98 |  |
|  |  |  |  |  | 1950 | 0.88 | 0.72 | 84.8 | 0 | 0.4 | 11.9 | 25 | 0.15 | 1.14 |  |
| 64 | Human hair |  | KOH | Hierarchical | 1230 | 0.9 |  | 66.41 | 0 | 8.33 | 25.26 | 0 | 1 | 5.14 | [67] |
|  |  |  |  |  | 2380 | 1.64 |  | 77.93 | 0 | 4.94 | 17.13 | 0 | 1 | 5.45 |  |
|  |  |  |  |  | 2700 | 1.33 |  | 80.95 | 0 | 3.45 | 15.6 | 0 | 1 | 4.27 |  |
| 65 | Polyacrylonitrile fiber | 300 | KOH | Hierarchical | 855 | 0.45 | 0.31 | 64.76 | 3.87 | 13.05 | 18.32 | 25 | 1 | 3.33 | [68] |
|  |  |  |  |  | 1338 | 0.68 | 0.49 | 66.54 | 4.01 | 11.32 | 18.13 | 25 | 1 | 3.57 |  |
|  |  |  |  |  | 1655 | 0.78 | 0.63 | 68.54 | 4.92 | 9.84 | 16.7 | 25 | 1 | 3.77 |  |
|  |  |  |  |  | 1980 | 0.92 | 0.76 | 73.15 | 4.82 | 7.38 | 14.65 | 25 | 1 | 3.95 |  |
|  |  |  |  |  | 2362 | 1.22 | 1.02 | 75.36 | 4.35 | 6.21 | 14.08 | 25 | 1 | 3.74 |  |
|  |  |  |  |  | 2430 | 1.37 | 1.16 | 74.98 | 3.98 | 5.36 | 15.68 | 25 | 1 | 3.51 |  |
|  |  |  |  |  | 2406 | 1.38 | 1.08 | 87.07 | 3.16 | 3.89 | 5.88 | 25 | 1 | 3.54 |  |
|  |  |  |  |  | 2672 | 1.58 | 1.31 | 88.06 | 3.87 | 3.04 | 5.03 | 25 | 1 | 3.16 |  |
|  |  |  |  |  | 2644 | 1.62 | 1.32 | 87.68 | 3.24 | 2.65 | 6.43 | 25 | 1 | 3.15 |  |
|  |  |  |  |  | 2112 | 1.26 | 0.92 | 92.23 | 3.56 | 2.83 | 1.38 | 25 | 1 | 3.02 |  |
|  |  |  |  |  | 2747 | 1.62 | 1.19 | 91.56 | 2.45 | 2.36 | 3.63 | 25 | 1 | 3.46 |  |
|  |  |  |  |  | 2436 | 1.57 | 1.15 | 94.33 | 1.78 | 1.84 | 2.05 | 25 | 1 | 3.23 |  |
|  |  |  |  |  | 855 | 0.45 | 0.31 | 64.76 | 3.87 | 13.05 | 18.32 | 0 | 1 | 4.19 |  |
|  |  |  |  |  | 1338 | 0.68 | 0.49 | 66.54 | 4.01 | 11.32 | 18.13 | 0 | 1 | 5.03 |  |
|  |  |  |  |  | 1655 | 0.78 | 0.63 | 68.54 | 4.92 | 9.84 | 16.7 | 0 | 1 | 5.61 |  |
|  |  |  |  |  | 1980 | 0.92 | 0.76 | 73.15 | 4.82 | 7.38 | 14.65 | 0 | 1 | 6.01 |  |
|  |  |  |  |  | 2362 | 1.22 | 1.02 | 75.36 | 4.35 | 6.21 | 14.08 | 0 | 1 | 6.37 |  |
|  |  |  |  |  | 2430 | 1.37 | 1.16 | 74.98 | 3.98 | 5.36 | 15.68 | 0 | 1 | 5.23 |  |
|  |  |  |  |  | 2406 | 1.38 | 1.08 | 87.07 | 3.16 | 3.89 | 5.88 | 0 | 1 | 5.76 |  |
|  |  |  |  |  | 2672 | 1.58 | 1.31 | 88.06 | 3.87 | 3.04 | 5.03 | 0 | 1 | 5.1 |  |
|  |  |  |  |  | 2644 | 1.62 | 1.32 | 87.68 | 3.24 | 2.65 | 6.43 | 0 | 1 | 5.47 |  |
|  |  |  |  |  | 2112 | 1.26 | 0.92 | 92.23 | 3.56 | 2.83 | 1.38 | 0 | 1 | 5.72 |  |
|  |  |  |  |  | 2747 | 1.62 | 1.19 | 91.56 | 2.45 | 2.36 | 3.63 | 0 | 1 | 4.94 |  |
|  |  |  |  |  | 2436 | 1.57 | 1.15 | 94.33 | 1.78 | 1.84 | 2.05 | 0 | 1 | 4.52 |  |
| 66 | Potassium bitartrate | 600-800 | KC4H5O6 | Hierarchical | 557 | 0.24 | 0.21 | 73.05 | 2.2 | 0.6 | 24.15 | 25 | 1 | 2.68 | [69] |
|  |  |  |  |  | 744 | 0.31 | 0.27 | 74.89 | 2.35 | 0.64 | 22.12 | 25 | 1 | 3.29 |  |
|  |  |  |  |  | 947 | 0.4 | 0.36 | 76.74 | 2.5 | 0.66 | 20.1 | 25 | 1 | 3.55 |  |
|  |  |  |  |  | 1156 | 0.56 | 0.46 | 78.87 | 1.92 | 0.78 | 18.43 | 25 | 1 | 3.38 |  |
|  |  |  |  |  | 1217 | 0.81 | 0.31 | 83.69 | 2.01 | 0.82 | 13.48 | 25 | 1 | 2.75 |  |
|  |  |  |  |  | 557 | 0.24 | 0.21 | 73.05 | 2.2 | 0.6 | 24.15 | 0 | 1 | 3.58 |  |
|  |  |  |  |  | 744 | 0.31 | 0.27 | 74.89 | 2.35 | 0.64 | 22.12 | 0 | 1 | 4.5 |  |
|  |  |  |  |  | 947 | 0.4 | 0.36 | 76.74 | 2.5 | 0.66 | 20.1 | 0 | 1 | 5 |  |
|  |  |  |  |  | 1156 | 0.56 | 0.46 | 78.87 | 1.92 | 0.78 | 18.43 | 0 | 1 | 5.16 |  |
|  |  |  |  |  | 1217 | 0.81 | 0.31 | 83.69 | 2.01 | 0.82 | 13.48 | 0 | 1 | 4.35 |  |
| 67 | Cotton stalk crop-residue |  | KOH | Microporous | 1897 | 0.744 | 0.706 | 65.56 | 3.37 | 1.87 | 26.32 | 25 | 1 | 3.49 | [70] |
|  |  |  |  |  | 1787 | 0.806 | 0.622 | 73 | 2.27 | 2.04 | 20.47 | 25 | 1 | 2.88 |  |
|  |  |  |  |  | 1706 | 0.777 | 0.598 | 66.16 | 1.98 | 1.33 | 29.05 | 25 | 1 | 3.47 |  |
|  |  |  |  |  | 1853 | 0.785 | 0.646 | 61.64 | 2.61 | 2.74 | 30.29 | 25 | 1 | 3.74 |  |
|  |  |  |  |  | 2087 | 0.872 | 0.768 | 59.55 | 1.53 | 2.27 | 34 | 25 | 1 | 3.85 |  |
|  |  |  |  |  | 2438 | 1.212 | 0.727 | 64.74 | 2.47 | 0.31 | 31.97 | 25 | 1 | 3.22 |  |
|  |  |  |  |  | 1897 | 0.744 | 0.706 | 65.56 | 3.37 | 1.87 | 26.32 | 0 | 1 | 4.88 |  |
|  |  |  |  |  | 1787 | 0.806 | 0.622 | 73 | 2.27 | 2.04 | 20.47 | 0 | 1 | 5.96 |  |
|  |  |  |  |  | 1706 | 0.777 | 0.598 | 66.16 | 1.98 | 1.33 | 29.05 | 0 | 1 | 5.85 |  |
|  |  |  |  |  | 1853 | 0.785 | 0.646 | 61.64 | 2.61 | 2.74 | 30.29 | 0 | 1 | 5.8 |  |
|  |  |  |  |  | 2087 | 0.872 | 0.768 | 59.55 | 1.53 | 2.27 | 34 | 0 | 1 | 6.23 |  |
|  |  |  |  |  | 2438 | 1.212 | 0.727 | 64.74 | 2.47 | 0.31 | 31.97 | 0 | 1 | 5.22 |  |

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