

## Supplementary material

# Biochar as a UV Stabilizer: Its Impact on the Photostability of Poly(butylene succinate) Biocomposites

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### Supplementary materials:

**Table S1.** Thermal decomposition products of PBSu/BC 1% during UV aging.

| Retention time (min) |               |                |                | M <sub>w</sub> | Assigned compound                                                                                          |
|----------------------|---------------|----------------|----------------|----------------|------------------------------------------------------------------------------------------------------------|
| PBSu/BC 1% 0d        | PBSu/BC 1% 7d | PBSu/BC 1% 14d | PBSu/BC 1% 21d |                |                                                                                                            |
| 1.78                 | 1.82          | 1.82           | 1.85           | 44             | CO, CO <sub>2</sub>                                                                                        |
| 2.39                 | 2.19          | 2.44           | 2.41           | 72             | 2-Propenoic acid or tetrahydrofuran                                                                        |
| 6.92                 | 7.00          | 7.11           | 7.17           | 86             | Pent-4-en-1-ol                                                                                             |
| 8.84                 | 8.84          | 8.93           | 8.99           | 90             | 1,4-Butanediol                                                                                             |
| n.d.                 | n.d.          | 9.80           | 9.84           | 110            | Not identified                                                                                             |
| 12.27                | 12.31         | 12.32          | 12.37          | 100            | Succinic anhydride                                                                                         |
| 12.67                | 12.66         | 12.69          | 12.67          | 142            | But-3-en-1-yl but-3-enoate                                                                                 |
| 14.45                | 14.43         | 14.47          | 14.47          | 155            | But-3-en-1-yl 4-oxobutanoate                                                                               |
| 18.07                | 18.09         | 18.29          | 18.32          | 174            | 4-(but-3-en-1-yloxy)-4-oxobutanoic acid                                                                    |
| 19.86                | 19.87         | 19.86          | 19.89          | 244            | But-3-en-1-yl (4-hydroxybutyl) succinate                                                                   |
| 24.87                | 24.86         | 24.86          | 24.78          | 230            | 4-(propionyloxy)butyl 4-oxobutanoate                                                                       |
| 25.33                | 25.34         | 25.38          | 25.41          | 258            | 4-(4-(but-3-enoyloxy)butoxy)-4-oxobutanoic acid                                                            |
| 27.46                | 27.44         | 27.41          | 27.42          | 399            | 4-((4-oxobutanoyl)oxy)butyl py y y )<br>(4-(propionyloxy)butyl) succinate bis(4-((4-oxobutanoyl)oxy)butyl) |
| 29.49                | 29.44         | 29.43          | 29.44          | 429            | bis(4-((4-oxobutanoyl)oxy)butyl) succinate                                                                 |

**Table S2.** Thermal decomposition products of PBSu/BC 2.5% during UV aging.

| Retention time (min) |                    |                     |                     | M <sub>w</sub> | Assigned compound                                                  |
|----------------------|--------------------|---------------------|---------------------|----------------|--------------------------------------------------------------------|
| PBSu/BC<br>2.5% 0d   | PBSu/BC<br>2.5% 7d | PBSu/BC<br>2.5% 14d | PBSu/BC<br>2.5% 21d |                |                                                                    |
| 1.78                 | 1.77               | 1.69                | 1.77                | 44             | CO, CO <sub>2</sub>                                                |
| 2.39                 | 2.38               | 2.37                | 2.37                | 72             | 2-Propenoic acid or tetrahydrofuran                                |
| 6.97                 | 6.96               | 6.97                | 6.89                | 86             | Pent-4-en-1-ol                                                     |
| 8.80                 | 8.64               | 8.73                | 8.65                | 90             | 1,4-Butanediol                                                     |
| 12.24                | 12.21              | 12.25               | 12.21               | 100            | Succinic anhydride                                                 |
| 12.57                | 12.54              | 12.58               | 12.65               | 142            | But-3-en-1-yl but-3-enoate                                         |
| 14.43                | 14.39              | 14.34               | 14.34               | 155            | But-3-en-1-yl 4-oxobutanoate                                       |
| 14.52                | 14.54              | 14.53               | 14.53               | 164            | 1,6-dioxecane-2,5-dione Di(but-3-en-1-yl)                          |
| 18.01                | 17.97              | 18.08               | 18.08               | 174            | 4-(but-3-en-1-yloxy)-4-oxobutanoic acid                            |
| 19.80                | 19.83              | 19.80               | 19.84               | 244            | But-3-en-1-yl (4-hydroxybutyl) succinate                           |
| 20.98                | 21.01              | 21.04               | 21.00               | 272            | 1,6,13-trioxacyclononadecane-7,12,14,19-tetraone                   |
| 24.80                | 24.73              | 24.71               | 24.75               | 230            | 4-(propionyloxy)butyl 4-oxobutanoate                               |
| 25.30                | 25.34              | 25.38               | 25.34               | 258            | 4-(4-(but-3-enoyloxy)butoxy)-4-oxobutanoic acid                    |
|                      |                    |                     |                     |                | 4-((4-oxobutanoyl)oxy)butyl py y) y )                              |
| 27.91                | 27.91              | 27.91               | 27.40               | 399            | (4-(propionyloxy)butyl) succinate bis(4-((4-oxobutanoyl)oxy)butyl) |
| 29.35                | 29.41              | 29.38               | 29.27               | 429            | bis(4-((4-oxobutanoyl)oxy)butyl) succinate                         |

**Table S3.** Thermal decomposition products of PBSu/BC 5% during UV aging.

| Retention time (min) |                  |                   |                   | M <sub>w</sub> | Assigned compound                   |
|----------------------|------------------|-------------------|-------------------|----------------|-------------------------------------|
| PBSu/BC<br>5% 0d     | PBSu/BC<br>5% 7d | PBSu/BC<br>5% 14d | PBSu/BC<br>5% 21d |                |                                     |
| 1.72                 | 1.73             | 1.80              | 1.64              | 44             | CO, CO <sub>2</sub>                 |
| 2.32                 | 2.37             | 2.35              | 2.33              | 72             | 2-Propenoic acid or tetrahydrofuran |
| 7.05                 | 7.14             | 7.00              | 6.92              | 86             | Pent-4-en-1-ol                      |
| 8.80                 | 8.94             | 8.70              | 8.62              | 90             | 1,4-Butanediol                      |
| n.d.                 | 9.84             | 9.84              | 9.77              | 110            | Not identified                      |

|       |       |       |       |     |                                                                                                                                      |
|-------|-------|-------|-------|-----|--------------------------------------------------------------------------------------------------------------------------------------|
| 12.27 | 12.27 | 12.21 | 12.20 | 100 | Succinic anhydride                                                                                                                   |
| 12.60 | 12.61 | 12.60 | 12.51 | 142 | But-3-en-1-yl but-3-enoate                                                                                                           |
| 14.32 | 14.41 | 14.41 | 14.36 | 155 | But-3-en-1-yl 4-oxobutanoate                                                                                                         |
| 14.55 | 14.52 | 14.53 | 14.48 | 164 | 1,6-dioxecane-2,5-dione Di(but-3-en-1-yl)                                                                                            |
| 18.06 | 18.05 | 18.11 | 18.03 | 174 | 4-(but-3-en-1-yloxy)-4-oxobutanoic acid                                                                                              |
| 19.81 | 19.86 | 19.89 | 19.84 | 244 | But-3-en-1-yl (4-hydroxybutyl) succinate                                                                                             |
| 20.98 | 21.05 | 21.03 | n.d.  | 272 | 1,6,13-trioxacyclononadecane-7,12,14,19-tetraone                                                                                     |
| 24.74 | 24.77 | 24.73 | 24.69 | 230 | 4-(propionyloxy)butyl 4-oxobutanoate                                                                                                 |
| 25.34 | 25.37 | 25.25 | 25.27 | 258 | 4-(4-(but-3-enoyloxy)butoxy)-4-oxobutanoic acid                                                                                      |
| n.d.  | n.d.  | 27.22 | n.d.  | 344 | 1,6,11,16-tetraoxacycloicosane-2,5,12,15-tetraone <i>or</i> 4-(4-((4-(but-3-en-1-yloxy)-4-oxobutanoyl)oxy)butoxy)-4-oxobutanoic acid |
| n.d.  | n.d.  | n.d.  | 28.20 | 399 | 4-((4-oxobutanoyl)oxy)butyl py y) y )<br>(4-(propionyloxy)butyl) succinate bis(4-((4-oxobutanoyl)oxy)butyl)                          |
| 29.34 | 29.41 | 29.35 | 29.16 | 429 | bis(4-((4-oxobutanoyl)oxy)butyl) succinate                                                                                           |

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