

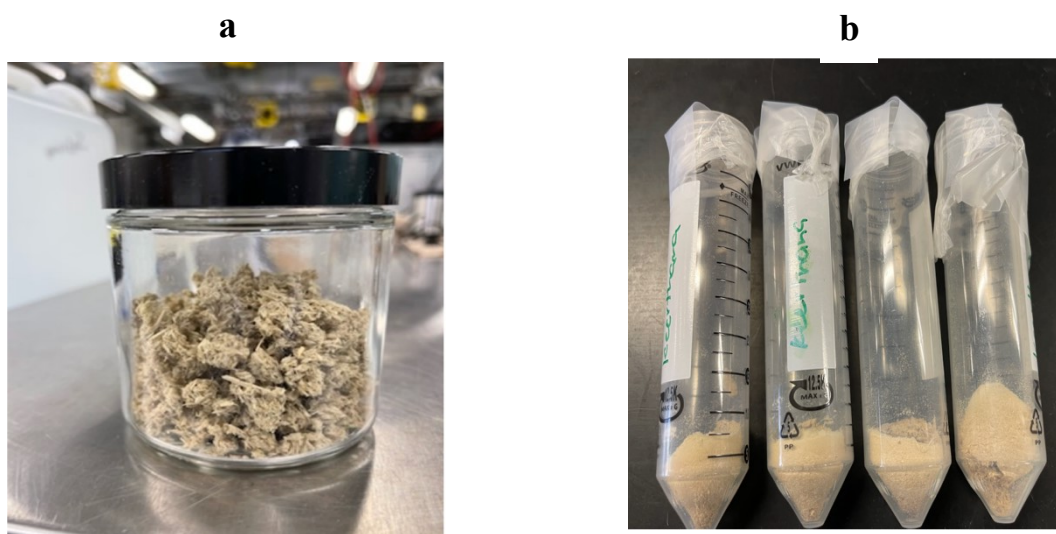
## ELECTRONIC SUPPLEMENTARY MATERIALS

### Incorporating biochar to make hydrogel composites with improved structural properties, valorized from waste-paper mill sludge and forestry residues using energy efficient protocols

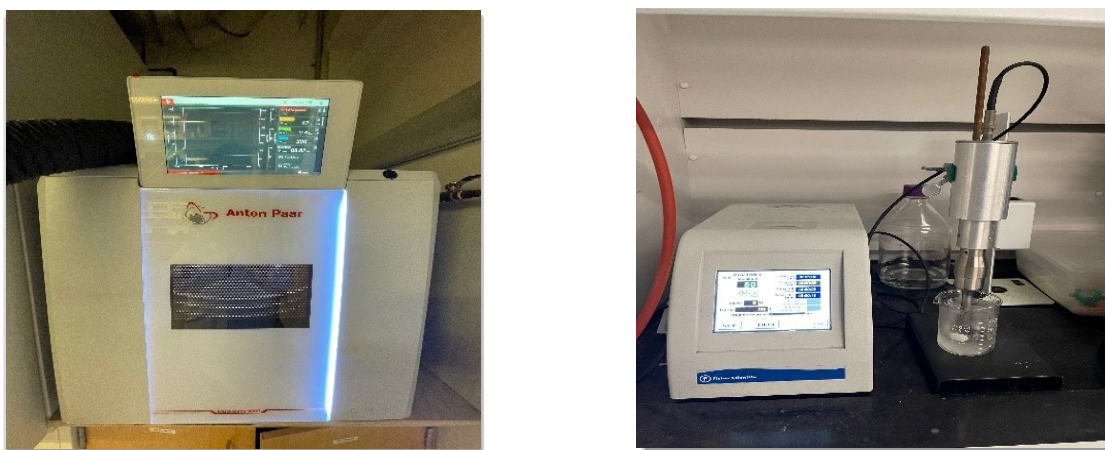
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**Fig S1.** (a) Paper mill sludge after preliminary cleaning (b) extracted cellulose



**Fig S2.** Microwave irradiation (left) and ultrasonication extraction (right) of cellulose from paper mill dewatered sludge

	<b>Cellulose (%)</b>	<b>Hemi cellulose (%)</b>	<b>Lignin (%)</b>
Dewatered sludge	66.56	19.11	12.3
Extracted cellulose	93.75	4.22	0.67

**Table S1**  
Chemical composition of dewatered sludge and extracted cellulose

**Table S2** ANOVA results for gel fraction of different hydrogel composites

<b>Category</b>	<b>LS means of gel fraction</b>	<b>Homogenous groups</b>		
BH1.5	86.19	A		
BH1	84.18		B	
BH0.5	82.32			C
CH	80.77			D

**Table S3** Swelling ratio of different hydrogel composites versus time

<b>Category</b>	<b>10h</b>	<b>20h</b>	<b>30h</b>	<b>40h</b>	<b>50h</b>	<b>60h</b>	<b>70h</b>
BH1	16.01 a	14.10 a	12.40 a	11.27 a	10.30 a	9.12 a	8.52 a
CH	14.88 b	12.63 b	11.00 b	10.04 ab	8.69 b	7.80 b	7.10 b
BH0.5	12.36 c	10.87 c	9.72 c	8.78 bc	7.69 c	7.03 c	6.35 c
BH1.5	10.46 d	9.76 c	9.05 c	8.49 c	7.78 c	6.80 c	6.16 c
<b>Category</b>	<b>Water absorbency (%)</b>						
BH	968.053 a						
CH	883.820 b						
BH0.5	804.007 c						
BH1.5	755.884 c						
Pr > F(Model)	<0.0001						
Pr>F(Model)	<0.0001	<0.0001	<0.0001	0.001	<0.0001	<0.0001	<0.0001
Significant		Yes	Yes	Yes	Yes	Yes	Yes

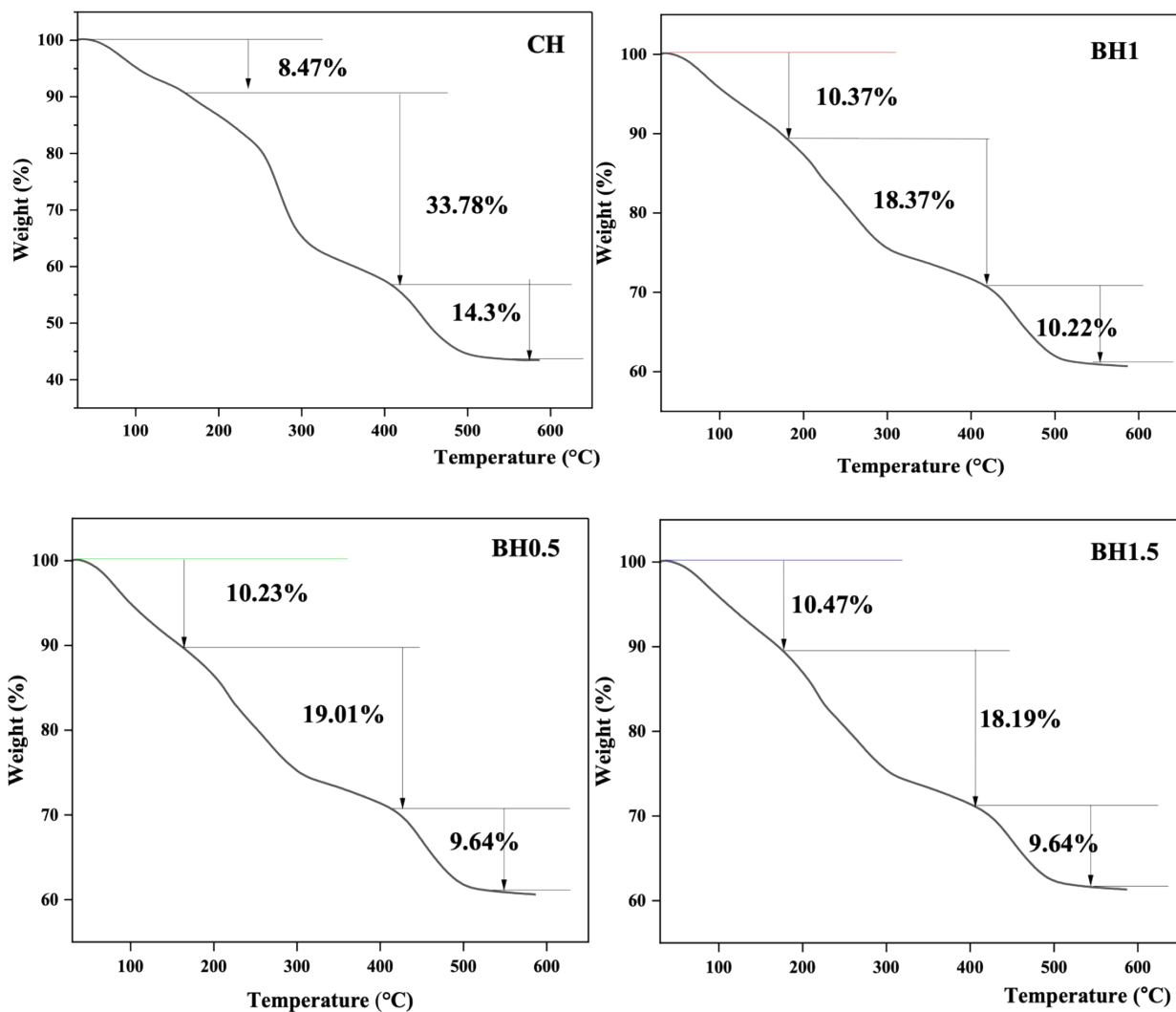
**Table S4** Water absorbency of different hydrogel composites

Significant

Yes

**Table S5** Water retention of different hydrogel composites

<b>Category</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>
BH	401.49 a	809.58 a	902.34 a	930.96 a	949.00 a	957.96 a	968.05 a
CH	375.15 a	745.88 a	768.90 a	816.03 a	792.54 a	809.11 a	883.82 a
BH0.5	396.82 a	622.41 a	678.35 a	686.42 a	757.56 a	783.63 a	804.01 a
BH1.5	383.96 a	618.61 a	605.98 a	682.47 a	734.62 a	732.29 a	755.88 a
Pr > F(Model)	0.696	0.048	0.001	0.013	0.001	0.000	<0.0001
Significant	No	Yes	Yes	Yes	Yes	Yes	Yes



**Fig S3** Weight loss profile thermograms for the cellulose biochar-hydrogel composites at various BC content

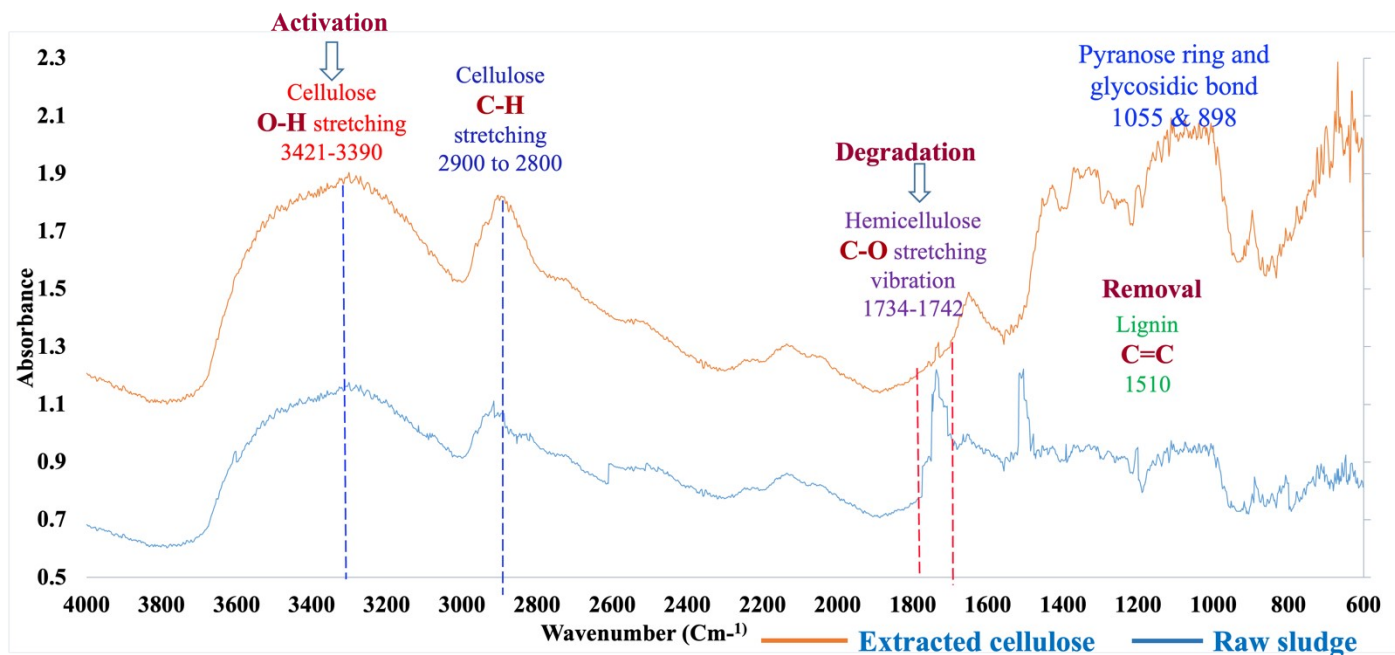


Fig S4. FTIR spectra of dewatered sludge and extracted cellulose.



Fig. S5 Performing water retention studies using tea bag method