

## Synthesis and performance evaluation of slow-release fertilizers produced from inverse vulcanized copolymers obtained from industrial waste

Ali Shaan Manzoor Ghumman <sup>a,b</sup>, Rashid Shamsuddin <sup>a,b,\*</sup>, Rabia Sabir <sup>c</sup>, Ammara Waheed <sup>c</sup>  
Abdul Sami<sup>b</sup> and Hamad Almohamadi<sup>d</sup>

<sup>a</sup> HICoE, Centre for Biofuel and Biochemical Research (CBBR), Institute of Self-Sustainable Building, Universiti Teknologi PETRONAS, 32610, Seri Iskandar, Perak, Malaysia.

<sup>b</sup> Chemical Engineering Department, Universiti Teknologi PETRONAS, 32610 Bandar Seri Iskandar, Perak Darul Ridzuan, Malaysia.

<sup>c</sup> Department of Chemical Engineering, Wah Engineering College, University of Wah, Wah Cantt, 47040, Punjab, Pakistan

<sup>d</sup> Department of Chemical Engineering, Faculty of Engineering, Islamic University of Madinah, Madinah Saudi Arabia.

\*Corresponding Author: [mrashids@utp.edu.my](mailto:mrashids@utp.edu.my)

### Supplementary Information:

Table S1: Primary Data for Nitrogen Release Test in Distilled Water.

Time (days)	Cumulative Nitrogen Release (%)								
	Pristine Urea	50-S-M-I	Std Dev	50-S-M-II	Std Dev	50-S-M-III	Std Dev	60-S-M-I	Std Dev
0	0	0	2.29595	0	0	0	0	0	0
1	99.8	14	2.46855	10	0.25066	9.5	1.23092	20	0.23105
2	100	22	2.57487	12.52	1.32725	15.028	4.11771	25	1.27165
3	100	25	2.65405	14.89	1.865	16.258	5.0644	26	0.18188
4	100	31.02	2.64198	16.03	2.52591	18.0258	2.93	28	0.63625
5	100	33	2.67197	22.089	1.32428	18.59	3.315	35	0.56731
6	-	35.84	2.50191	25.148	2.06019	19.0258	2.33	36	0.58652
7	-	40.025	2.34733	25.56	2.61118	20.023	2.17	38	0.59094
8	-	43	1.90608	25.89	2.86119	28.9	1.9	47	0.59094
9	-	45	1.55781	26.29	2.08506	30	1.095	53	0.22235
10	-	55.048	1.23396	35.68	2.08506	30.056	0.58	64	0.22372
11	-	60	1.10129	38.025	1.86304	30.58	1.5	71.25	0.22479
12	-	62.085	0.8998	40.24	2.0857	30.856	1.15	75.18	0.22587
13	-	68.254	0.97294	41.85	2.21951	35.26	1.68	83.28	0.19211
14	-	74.2365	0.97874	44.158	2.29595	40.015	1.96	93.05	0.0013
15	-	78.956	0.86264	45.02	2.46855	42.015	2.085	98.85	0.0013
16	-	83.54	0.7539	50.0369	2.57487	43.28	1.98	99.5	0.0013
17	-	88.45	0.30188	55.214	2.65405	44.15	2.34	100	0.0013
18	-	94.35	0.3331	58.9	2.64198	48.59	2.505	-	-
19	-	98.45	0.36579	62.15	2.67197	56.45	0.98	-	-

20	-	98.79	0.18778	63.145	2.50191	67.15	1.345	-	-
21	-	99.45	0.24698	63.89	2.34733	75.26	1.045	-	-
22	-	100	0.29671	65.248	1.90608	75.45	0.105	-	-
23	-	-	-	66	1.55781	75.78	1.08	-	-
24	-	-	-	68.248	1.23396	76.25	1	-	-
25	-	-	-	75.25	1.10129	78.154	0.45	-	-
26	-	-	-	78.25	0.8998	78.45	0.91	-	-
27	-	-	-	79.24	0.97294	78.894	0.985	-	-
28	-	-	-	80.24	0.97874	79.35	0.87	-	-
29	-	-	-	83.25	0.86264	85.02	0.39	-	-
30	-	-	-	85	0.7539	90.23	0.285	-	-

Table S2: Primary data for biodegradability test

Time	Weight Loss (%)
5	0.5
10	2
15	3.5
20	5.25
25	7.25
30	9.48
35	12.02
40	14.48
45	15.47
50	18.25