

The Potential of AHP-TOPSIS and Fuzzy-TOPSIS Hybrid MCDM Techniques for Evaluation of Mature Landfill Leachate Treatment Technologies

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Table No.	Content	Page
Table S1	Saaty's Nine-Point Scale for Pairwise Comparisons in the Analytic Hierarchy Process (AHP)	2
Table S2	Pairwise criteria matrix comparison (A1) and normalized criteria weights (A2) using AHP.	2
Table S3	Random Index Values for Consistency Evaluation in Analytic Hierarchy Process (AHP)	2
Table S4	Performance rating matrix of alternatives associated with ten criteria	2
Table S5	Normalized weight of alternatives	3
Table S6	Linguistic variables and corresponding triangular Fuzzy scale weights	3
Table S7	Pairwise comparison matrix of criteria in terms of Fuzzy linguistic term	3
Table S8	Pairwise criteria matrix comparison and normalized criteria weights using Fuzzy	3-4
Table S9	Normalized Decision Matrix (R_{ij})	4
Table S10	Weighted Normalized Matrix AHP- TOPSIS (V_{ij})	4
Table S11	Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS) using AHP-TOPSIS	4
Table S12	Separation measure and relative closeness using AHP-TOPSIS	5
Table S13	Weighted normalized matrix by Fuzzy-TOPSIS	5
Table S14	Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS) using Fuzzy-TOPSIS	5
Table S15	Separation measure and relative closeness using Fuzzy-TOPSIS	5-6

Table S1 Saaty's Nine-Point Scale for Pairwise Comparisons in the Analytic Hierarchy Process (AHP)

Values	Judgement Terms
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Absolute Importance
2,4,6,8	Comparison values between the above values

Table S2 Pairwise criteria matrix comparison (A1) and normalized criteria weights (A2) using AHP

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Normalized weight
C1	1	2	2	3	3	3	5	6	8	8	0.2449
C2	1/2	1	2	2	2	2	4	5	7	7	0.1765
C3	1/2	1/2	1	2	2	2	4	5	7	7	0.1537
C4	1/3	1/2	1/2	1	2	2	3	4	6	6	0.1184
C5	1/3	1/2	1/2	1/2	1	2	3	4	6	6	0.1030
C6	1/3	1/2	1/2	1/2	1/2	1	2	3	6	6	0.0837
C7	1/5	1/4	1/4	1/3	1/3	1/2	1	2	4	4	0.0492
C8	1/6	1/5	1/5	1/4	1/4	1/3	1/2	1	3	3	0.0344
C9	1/8	1/7	1/7	1/6	1/6	1/6	1/4	1/3	1	2	0.0194
C10	1/8	1/7	1/7	1/6	1/6	1/6	1/4	1/3	1/2	1	0.0168

Table S3 Random Index Values for Consistency Evaluation in Analytic Hierarchy Process (AHP)

Attribute	3	4	5	6	7	8	9	10
RI	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Table S4 Performance rating matrix of alternatives associated with ten criteria

Criteria	C1 ^a	C2 ^a	C3 ^a	C4 ^a	C5 ^b	C6 ^b	C7 ^b	C8 ^b	C9 ^a	C10 ^a
A1	70	60	99	90	99	70	15	15	40	30
A2	76	60	80	85	99	70	25	15	30	25
A3	73	60	80	83	99	50	20	30	10	20
A4	70	60	95	86	65	90	40	30	20	20
A5	20	30	90	90	90	97	15	15	50	20
A6	85	50	80	90	99	87	80	70	50	80
A7	75	75	65	75	90	80	60	60	50	80
A8	80	70	79	99	60	30	50	50	70	40
A9	65	70	76	84	65	55	80	60	20	50
A10	70	70	96	95	88	30	55	70	90	70
A11	80	40	70	70	95	20	35	40	80	60
A12	75	70	50	60	75	30	80	20	50	50
A13	80	90	60	20	30	87	20	25	80	90
A14	70	60	99	90	45	90	80	70	80	80
A15	70	60	90	85	50	90	80	70	80	80
	85	90	99	99	30	20	15	15	90	90

a= beneficiary criteria; b= non- beneficiary criteria

Table S5 Normalized weight of alternatives

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	0.8235	0.6667	1	0.9091	0.3030	0.2857	1	1	0.4444	0.3333
A2	0.8941	0.6667	0.8081	0.8586	0.3030	0.2857	0.6000	1	0.3333	0.2778
A3	0.8588	0.6667	0.8081	0.8384	0.3030	0.4000	0.7500	0.5000	0.1111	0.2222
A4	0.8235	0.6667	0.9596	0.8687	0.4615	0.2222	0.3750	0.5000	0.2222	0.2222
A5	0.2353	0.3333	0.9091	0.9091	0.3333	0.2062	1	1	0.5556	0.2222
A6	1	0.5556	0.8081	0.9091	0.3030	0.2299	0.1875	0.2143	0.5556	0.8889
A7	0.8824	0.8333	0.6566	0.7576	0.3333	0.2500	0.2500	0.2500	0.5556	0.8889
A8	0.9412	0.7778	0.7980	1	0.5000	0.6667	0.3000	0.3000	0.7778	0.4444
A9	0.7647	0.7778	0.7677	0.8485	0.4615	0.3636	0.1875	0.2500	0.2222	0.5556
A10	0.8235	0.7778	0.9697	0.9596	0.3409	0.6667	0.2727	0.2143	1	0.7778
A11	0.9412	0.4444	0.7071	0.7071	0.3158	1	0.4286	0.3570	0.8889	0.6667
A12	0.8824	0.7778	0.5051	0.6061	0.4000	0.6667	0.1875	0.7500	0.5556	0.5556
A13	0.9412	1	0.6061	0.2020	1	0.2299	0.7500	0.6000	0.8889	1
A14	0.8235	0.6667	1	0.9091	0.6667	0.2222	0.1875	0.2143	0.8889	0.8889
A15	0.8235	0.6667	0.9091	0.8586	0.6000	0.2222	0.1875	0.2143	0.8889	0.8889

Table S6 Linguistic variables and corresponding triangular Fuzzy scale weights

Linguistic variables	Triangular fuzzy scale weights
Excessively Low (ExL)	0.002
Extremely Low (EL)	0.05
Very Low (VL)	0.17
Low(L)	0.29
Semi- Low (SL)	0.41
Neither Low Neither High (NL NH)	0.53
Semi- High (SH)	0.65
High (H)	0.77
Very High (VH)	0.825
Extremely High (EH)	0.88
Excessively High (ExH)	0.95

Table S7 Pairwise comparison matrix of criteria in terms of Fuzzy linguistic term

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	SH	SH	SH	SH	SH	H	VH	EH	EH
C2	SL	0	SH	SH	SH	SH	H	H	VH	VH
C3	SL	SL	0	SH	SH	SH	H	H	VH	VH
C4	SL	SL	SL	0	SH	SH	SH	H	VH	VH
C5	SL	SL	SL	SL	0	SH	SH	H	VH	VH
C6	SL	SL	SL	SL	SL	0	SH	SH	VH	VH
C7	L	L	L	SL	SL	SL	0	SH	H	H
C8	VL	L	L	L	L	SL	SL	0	SH	SH
C9	EL	VL	VL	VL	VL	VL	L	SL	0	SH
C10	EL	VL	VL	VL	VL	VL	L	SL	SL	0

Table S8 Pairwise criteria matrix comparison and normalized criteria weights using Fuzzy

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Normalized Weight
C1	0	0.65	0.65	0.65	0.65	0.65	0.77	0.825	0.88	0.88	0.1414
C2	0.41	0	0.65	0.65	0.65	0.65	0.77	0.77	0.825	0.825	0.1327

C3	0.41	0.41	0	0.65	0.65	0.65	0.77	0.77	0.825	0.825	0.1276
C4	0.41	0.41	0.41	0	0.65	0.65	0.65	0.77	0.825	0.825	0.1199
C5	0.41	0.41	0.41	0.41	0	0.65	0.65	0.77	0.825	0.825	0.1147
C6	0.41	0.41	0.41	0.41	0.41	0	0.65	0.65	0.825	0.825	0.1070
C7	0.29	0.29	0.29	0.41	0.41	0.41	0	0.65	0.77	0.77	0.0918
C8	0.17	0.29	0.29	0.29	0.29	0.41	0.41	0	0.65	0.65	0.0738
C9	0.5	0.17	0.17	0.17	0.17	0.17	0.29	0.41	0	0.65	0.0482
C10	0.5	0.17	0.17	0.17	0.17	0.17	0.29	0.41	0.41	0	0.0430

Table S9 Normalized Decision Matrix (R_{ij})

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	0.2508	0.2451	0.3123	0.2824	0.3207	0.2579	0.0701	0.0809	0.1754	0.1322
A2	0.2723	0.2451	0.2524	0.2667	0.3207	0.2579	0.1168	0.0809	0.1316	0.1101
A3	0.2615	0.2451	0.2524	0.2605	0.3207	0.1842	0.0934	0.1617	0.0439	0.0881
A4	0.2508	0.2451	0.2997	0.2699	0.2106	0.3316	0.1869	0.1617	0.0877	0.0881
A5	0.0717	0.1226	0.2839	0.2824	0.2916	0.3574	0.0701	0.0809	0.2193	0.0881
A6	0.3045	0.2043	0.2524	0.2824	0.3207	0.3205	0.3737	0.3774	0.2193	0.3524
A7	0.2687	0.3064	0.2051	0.2354	0.2916	0.2947	0.2803	0.3235	0.2193	0.3524
A8	0.2866	0.2860	0.2492	0.3107	0.1944	0.1105	0.2336	0.2696	0.3070	0.1762
A9	0.2329	0.2860	0.2398	0.2636	0.2106	0.2026	0.3737	0.3235	0.0877	0.2203
A10	0.2508	0.2860	0.3028	0.2981	0.2851	0.1105	0.2569	0.3774	0.3947	0.3084
A11	0.2866	0.1634	0.2208	0.2197	0.3078	0.0737	0.1635	0.2157	0.3508	0.2643
A12	0.2687	0.2860	0.1577	0.1883	0.2430	0.1105	0.3737	0.1078	0.2193	0.2203
A13	0.2866	0.3677	0.1893	0.0628	0.0972	0.3205	0.0934	0.1348	0.3508	0.3965
A14	0.2508	0.2451	0.3123	0.2824	0.1458	0.3316	0.3737	0.3774	0.3508	0.3524
A15	0.2508	0.2451	0.2839	0.2667	0.1620	0.3316	0.3737	0.3774	0.3508	0.3524

Table S10 Weighted Normalized Matrix AHP- TOPSIS (V_{ij})

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	0.0614	0.0433	0.0480	0.0334	0.0330	0.0216	0.0034	0.0028	0.0034	0.0022
A2	0.0667	0.0433	0.0388	0.0316	0.0330	0.0216	0.0057	0.0028	0.0025	0.0019
A3	0.0641	0.0433	0.0388	0.0308	0.0330	0.0154	0.0046	0.0056	0.0008	0.0015
A4	0.0614	0.0433	0.0461	0.0319	0.0217	0.0278	0.0092	0.0056	0.0017	0.0015
A5	0.0175	0.0216	0.0436	0.0334	0.0300	0.0299	0.0034	0.0028	0.0042	0.0015
A6	0.0746	0.0361	0.0388	0.0334	0.0330	0.0268	0.0184	0.0130	0.0042	0.0059
A7	0.0658	0.0541	0.0315	0.0279	0.0300	0.0247	0.0138	0.0111	0.0042	0.0059
A8	0.0702	0.0505	0.0383	0.0368	0.0200	0.0093	0.0115	0.0093	0.0059	0.0030
A9	0.0570	0.0505	0.0368	0.0312	0.0217	0.0170	0.0184	0.0111	0.0017	0.0037
A10	0.0614	0.0505	0.0465	0.0353	0.0294	0.0093	0.0126	0.0130	0.0076	0.0052
A11	0.0702	0.0288	0.0339	0.0260	0.0317	0.0062	0.0080	0.0074	0.0068	0.0045
A12	0.0658	0.0505	0.0242	0.0223	0.0250	0.0093	0.0184	0.0037	0.0042	0.0037
A13	0.0702	0.0649	0.0291	0.0074	0.0100	0.0268	0.0046	0.0046	0.0068	0.0067
A14	0.0614	0.0433	0.0480	0.0334	0.0150	0.0278	0.0184	0.0130	0.0068	0.0059
A15	0.0614	0.0433	0.0436	0.0316	0.0167	0.0278	0.0184	0.0130	0.0068	0.0059

Table S11 Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS) using AHP-TOPSIS

Vj+	0.0746	0.0649	0.0480	0.0368	0.0100	0.0062	0.0034	0.0028	0.0076	0.0067
Vj-	0.0175	0.0216	0.0242	0.0074	0.0330	0.0299	0.0184	0.0130	0.0008	0.0015

Table S12 Separation measure and relative closeness using AHP-TOPSIS

S_i^+	S_i^-	$(S_i^- + S_i^+)$	P_i^+
0.0382	0.0635	0.1017	0.6246
0.0383	0.0633	0.1016	0.6234
0.0374	0.0620	0.0994	0.6239
0.0371	0.0612	0.0982	0.6228
0.0785	0.0374	0.1159	0.3229
0.0472	0.0663	0.1134	0.5841
0.0384	0.0628	0.1012	0.6204
0.0235	0.0731	0.0967	0.7564
0.0355	0.0585	0.0940	0.6222
0.0310	0.0675	0.0985	0.6855
0.0464	0.0633	0.1097	0.5772
0.0392	0.0630	0.1023	0.6165
0.0409	0.0744	0.1152	0.6454
0.0384	0.0634	0.1018	0.6229
0.0391	0.0607	0.0997	0.6082

Table S13 Weighted normalized matrix by Fuzzy-TOPSIS

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	0.0359	0.0335	0.0411	0.0347	0.0370	0.0284	0.0061	0.0054	0.0080	0.0054
A2	0.0390	0.0335	0.0332	0.0328	0.0370	0.0284	0.0102	0.0054	0.0060	0.0045
A3	0.0375	0.0335	0.0332	0.0320	0.0370	0.0203	0.0081	0.0107	0.0020	0.0036
A4	0.0359	0.0335	0.0395	0.0332	0.0243	0.0365	0.0163	0.0107	0.0040	0.0036
A5	0.0103	0.0168	0.0374	0.0347	0.0336	0.0393	0.0061	0.0054	0.0100	0.0036
A6	0.0436	0.0280	0.0332	0.0347	0.0370	0.0353	0.0325	0.0251	0.0100	0.0143
A7	0.0385	0.0419	0.0270	0.0289	0.0336	0.0324	0.0244	0.0215	0.0100	0.0143
A8	0.0410	0.0391	0.0328	0.0382	0.0224	0.0122	0.0203	0.0179	0.0141	0.0072
A9	0.0333	0.0391	0.0316	0.0324	0.0243	0.0223	0.0325	0.0215	0.0040	0.0090
A10	0.0359	0.0391	0.0399	0.0367	0.0329	0.0122	0.0224	0.0251	0.0181	0.0125
A11	0.0410	0.0224	0.0291	0.0270	0.0355	0.0081	0.0142	0.0143	0.0161	0.0107
A12	0.0385	0.0391	0.0208	0.0232	0.0280	0.0122	0.0325	0.0072	0.0100	0.0090
A13	0.0410	0.0503	0.0249	0.0077	0.0112	0.0353	0.0081	0.0090	0.0161	0.0161
A14	0.0359	0.0335	0.0411	0.0347	0.0168	0.0365	0.0325	0.0251	0.0161	0.0143
A15	0.0359	0.0335	0.0374	0.0328	0.0187	0.0365	0.0325	0.0251	0.0161	0.0143

Table S14 Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS) using Fuzzy-TOPSIS

Vj+	0.0436	0.0503	0.0411	0.0382	0.0112	0.0081	0.0061	0.0054	0.0181	0.0161
Vj-	0.0103	0.0168	0.0208	0.0077	0.0370	0.0393	0.0325	0.0251	0.0020	0.0036

Table S15 Separation measure and relative closeness using Fuzzy-TOPSIS

S_i^+	S_i^-	$(S_i^- + S_i^+)$	P_i^+
0.0405	0.0577	0.0983	0.5874
0.0420	0.0540	0.0960	0.5624
0.0410	0.0541	0.0951	0.5692
0.0428	0.0508	0.0936	0.5427
0.0629	0.0466	0.1095	0.4253
0.0560	0.0482	0.1041	0.4625
0.0462	0.0473	0.0935	0.5056
0.0283	0.0619	0.0902	0.6865
0.0440	0.0475	0.0915	0.5192
0.0366	0.0596	0.0962	0.6198
0.0427	0.0557	0.0984	0.5656
0.0437	0.0526	0.0963	0.5463
0.0442	0.0631	0.1073	0.5878

0.0478	0.0530	0.1008	0.5259
0.0484	0.0500	0.0984	0.5083
