Closed landfill as an anaerobic digester for treating young leachate

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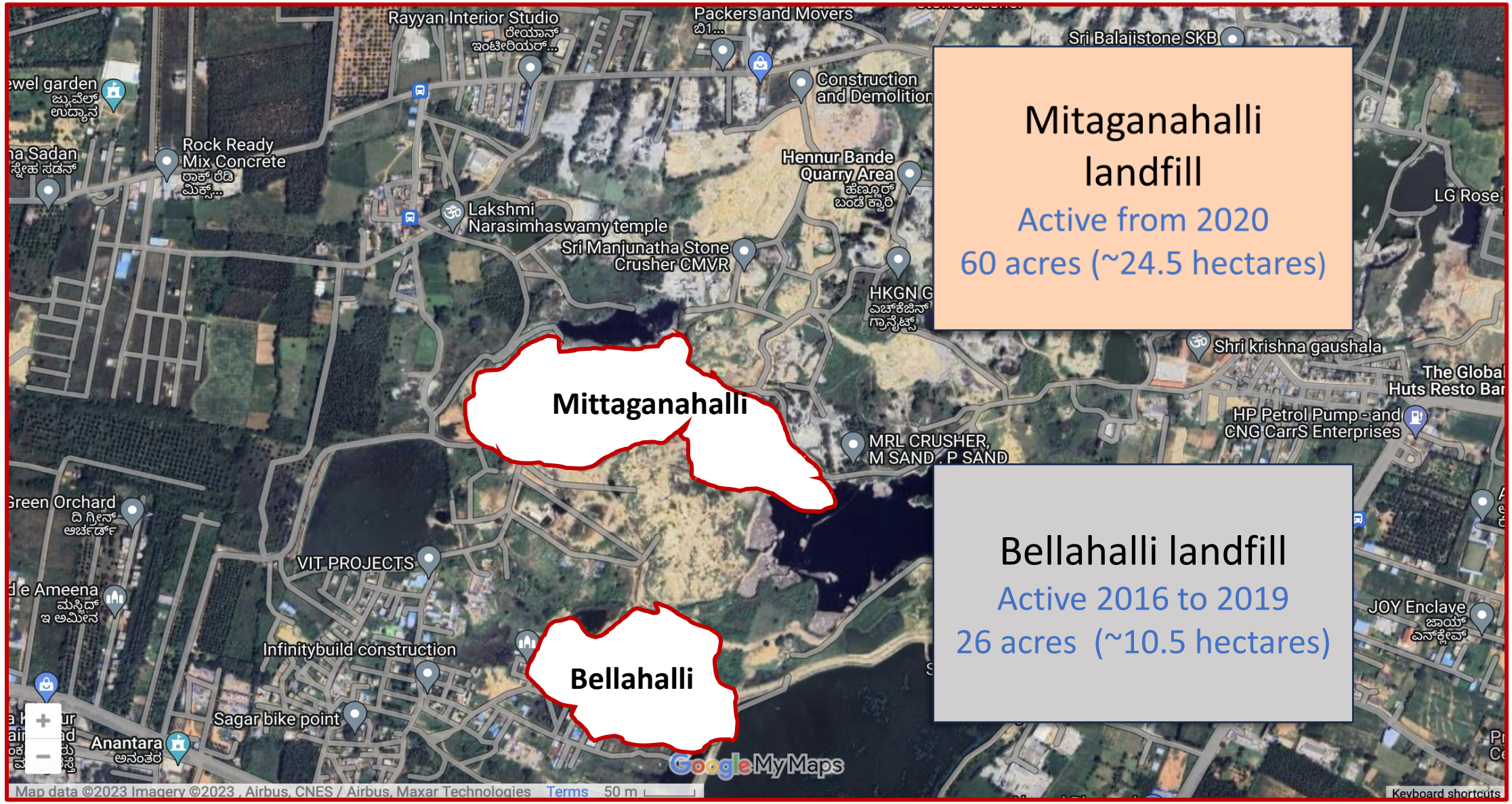
India Climatic Zone Map
Climatic zones (Köppen classification)
Montane
Humid subtropical
Tropical wet and dry
Tropical wet
Semi-arid
Arid
NATIONAL CAPITAL
State Capital
Union Territory Capital
JAMMU & KASHMIR
Srinagar
HIMACHAL PRADESH
Shimla
Chandigarh
Dehradun
UTTARANCHAL
HARYANA
NEW DELHI
RAJASTHAN
Jaipur
UTTAR PRADESH
Lucknow
SIKKIM
Gangtok
ARUNACHAL PRADESH
Itanagar
ASSAM
Guwahati
Shillong
NAGALAND
Kohima
BIHAR
Patna
MEGHALAYA
Imphal
MANIPUR
Aizwal
MIZORAM
Agartala
TRIPURA
Gandhinagar
GUJARAT
MADHYA PRADESH
Bhopal
JHARKHAND
Ranchi
WEST BENGAL
KOLKATA
CHHATTISGARH
Raipur
ORISSA
Bhubaneshwar
Diu
Daman & Diu
Silvasaa
Dadra & Nagar Haveli
MAHARASHTRA
MUMBAI
Hyderabad
ANDHRA PRADESH
Pondicherry (Yanam)
Panaji
GOA
KARNATAKA
Bangalor
CHENNAI
Pondicherry (Puducherry)
Pondicherry (Karaikal)
Pondicherry (Mahe)
Lakshadweep
Kavaratti
Islands
TAMIL NADU
KERALA
Thiruvananthapuram
Andaman & Nicobar Islands
Port Blair

What is the problem?

Handling of leachate



Estimation of the leachate quantity

Standard Method

$$V = 0.15 \times R \times A$$

R – average annual rainfall (m) Annual rainfall Bangalore city -1325 mm

A – surface area of landfill (m^2)

Closed landfill

Volume of leachate generated in Mittiganahalli landfill site is 24.13 m^3/year

Quantity leachate is >75% total precipitation 120.64 m^3/year

Active landfill

Challenges

- Leachate quantity in active landfill is high compared to the closed landfills
- Active landfill leachate is highly biodegradable
- Leachate treatment unit requirements differs as biodegradability and quantity will decrease over time

Solution :

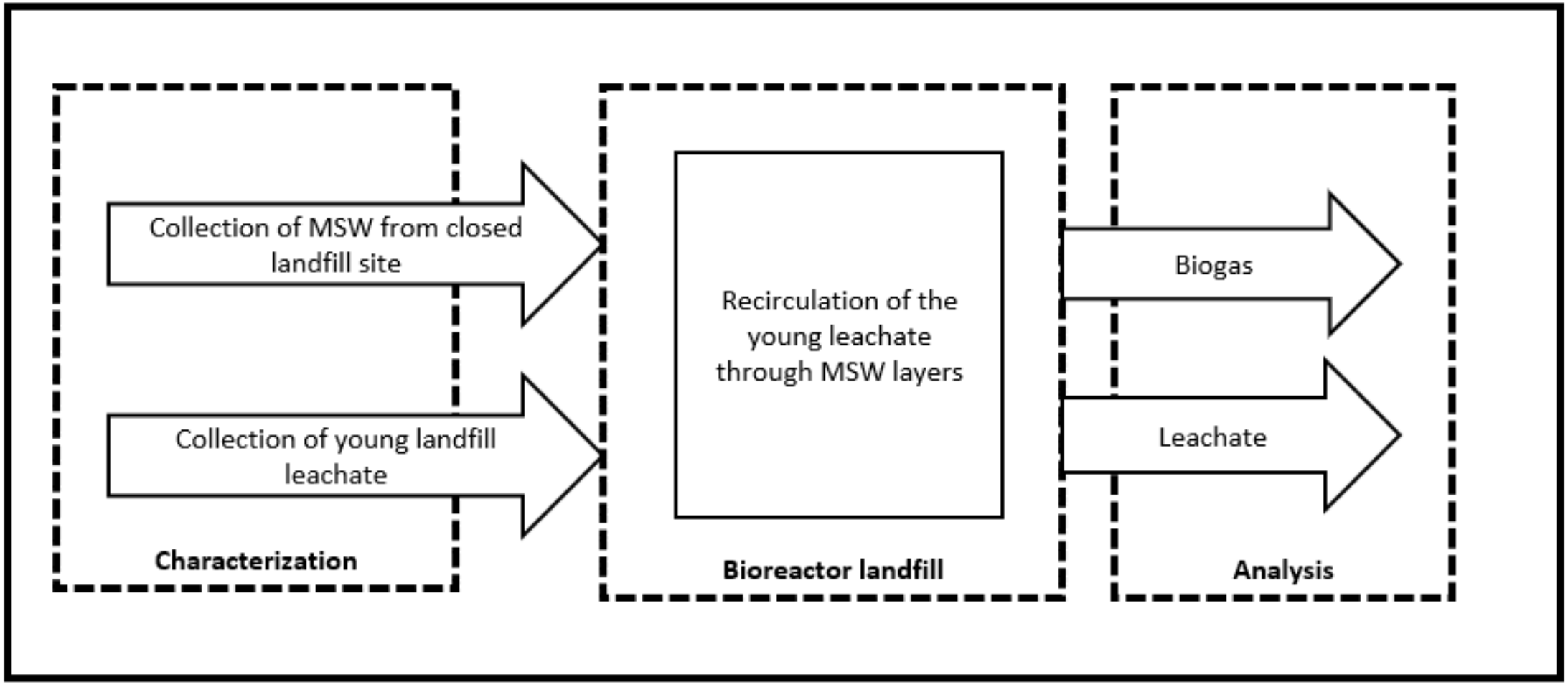
Recirculating active leachate in the closed landfill

Objective

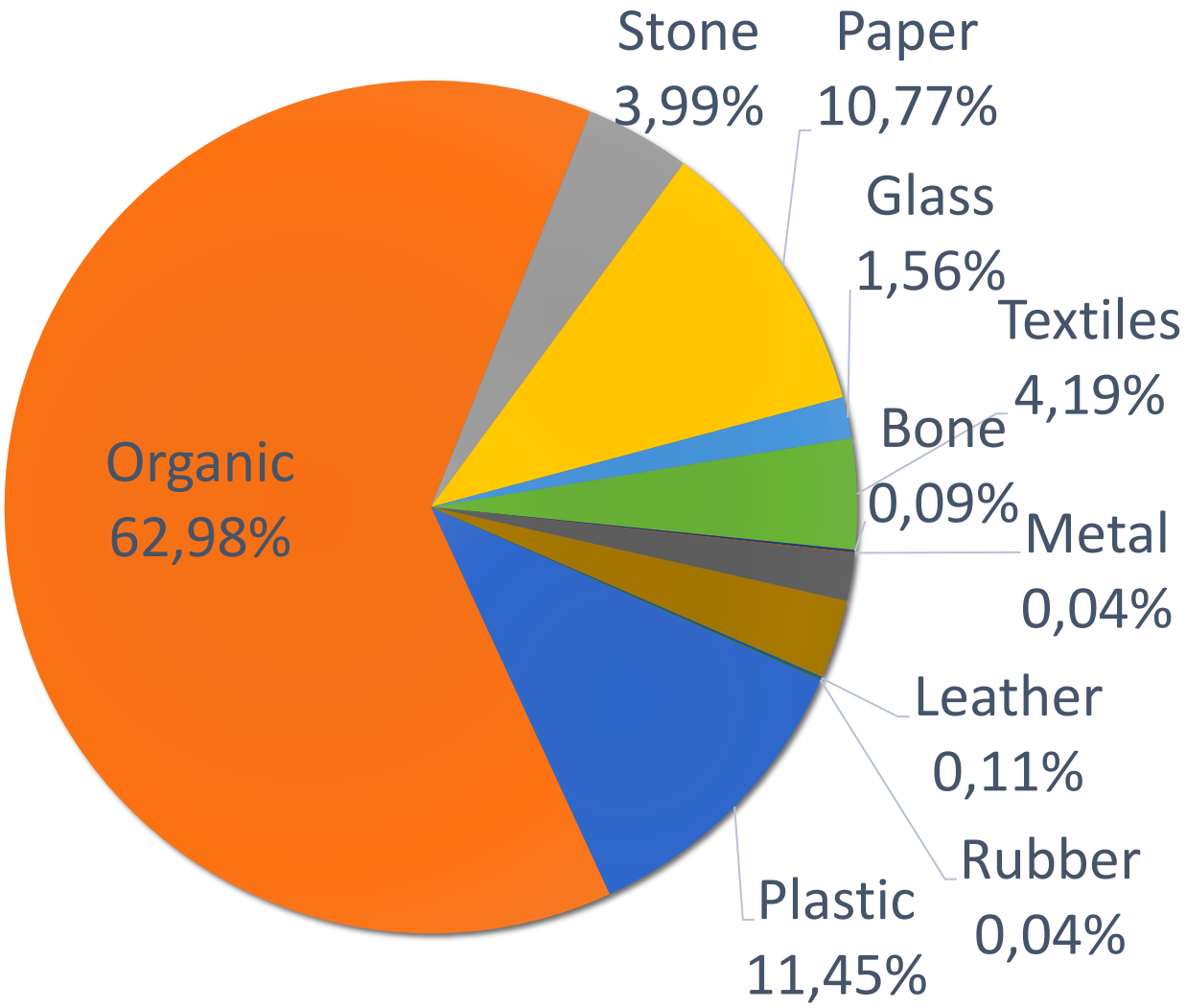
- To treat active leachate by recirculating in a solid-state stratified bed reactor using MSW collected from a closed landfill site

- To study the effect of recirculation on MSW by measuring gas production, settlement, and the characteristics of the recirculated leachate.

Methodology



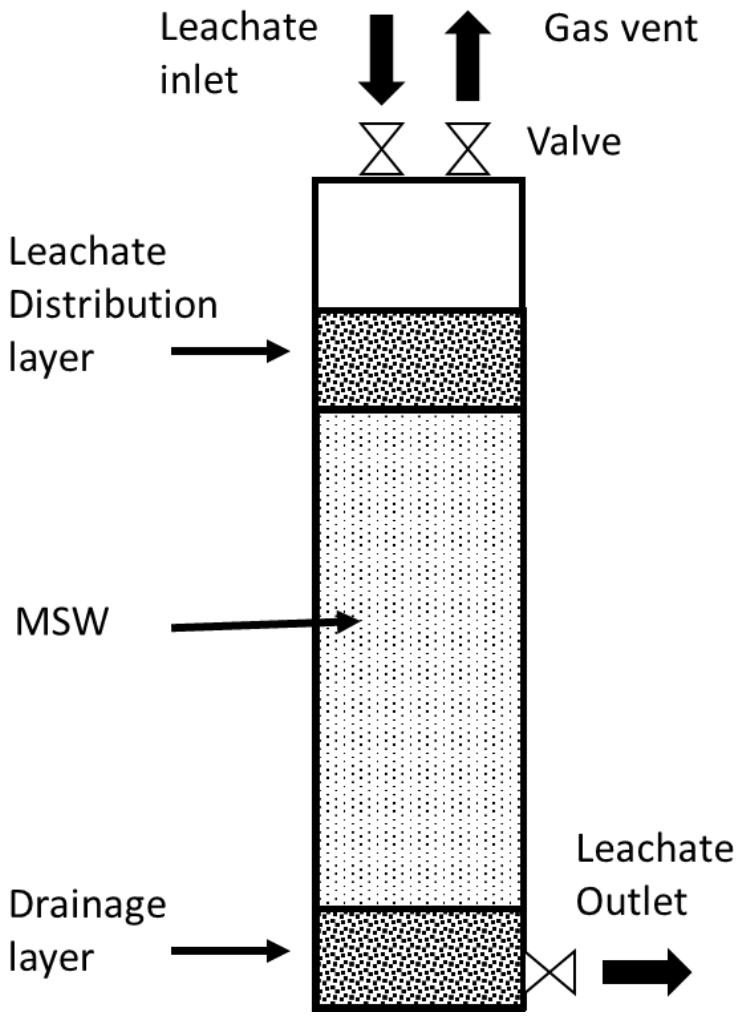
MSW characteristics



Parameters	Closed Landfill leachate	Active Landfill leachate
pH	7.69	5.85
Electrical Conductivity µS/cm	17400.00	37346.67
Total Dissolved solids mg/l	12800.00	23280.00
Biochemical oxygen demand mg/l	7200.00	10450.00
Chemical Oxygen Demand mg/l	16000.00	31500.00
Sulphate as SO_4, mg/l	165.80	1427.17
Chloride as Cl, mg/l	1949.75	3072.33
Total Alkalinity as $CaCO_3$, mg/l	7800.00	12833.33
Sodium as Na, mg/l	718.00	3828.33
Potassium as K, mg/l	659.00	2943.33
Nitrate as NO_3, mg/l	1376.00	1809.17
Total phosphorous as P, mg/l	20.14	59.00
Ammoniacal nitrogen as N, mg/l	509.20	43.03
Total Kjeldahl nitrogen as N, mg/l	1273.00	1152.79
Nitrite as NO_2, mg/l	<0.1	<0.1

Reactor study

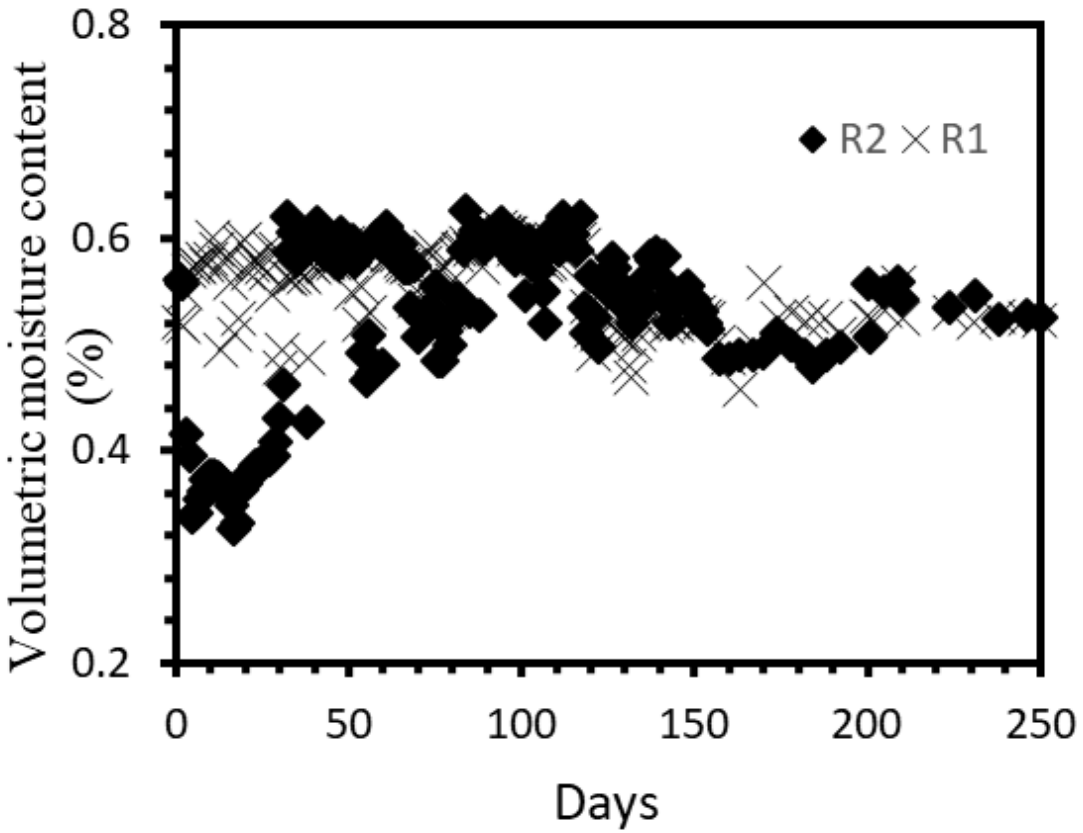
- MSW components greater than 20 mm screen was shredded and blended well prior to being placed in the reactors.
- Waste was hydrated to 30% water content and packed in a cylindrical reactor of 1000 mm height and 170 mm diameter.
- MSW layer is compacted in six lifts to obtain a packing density of 620 ± 10 kg/m^3.

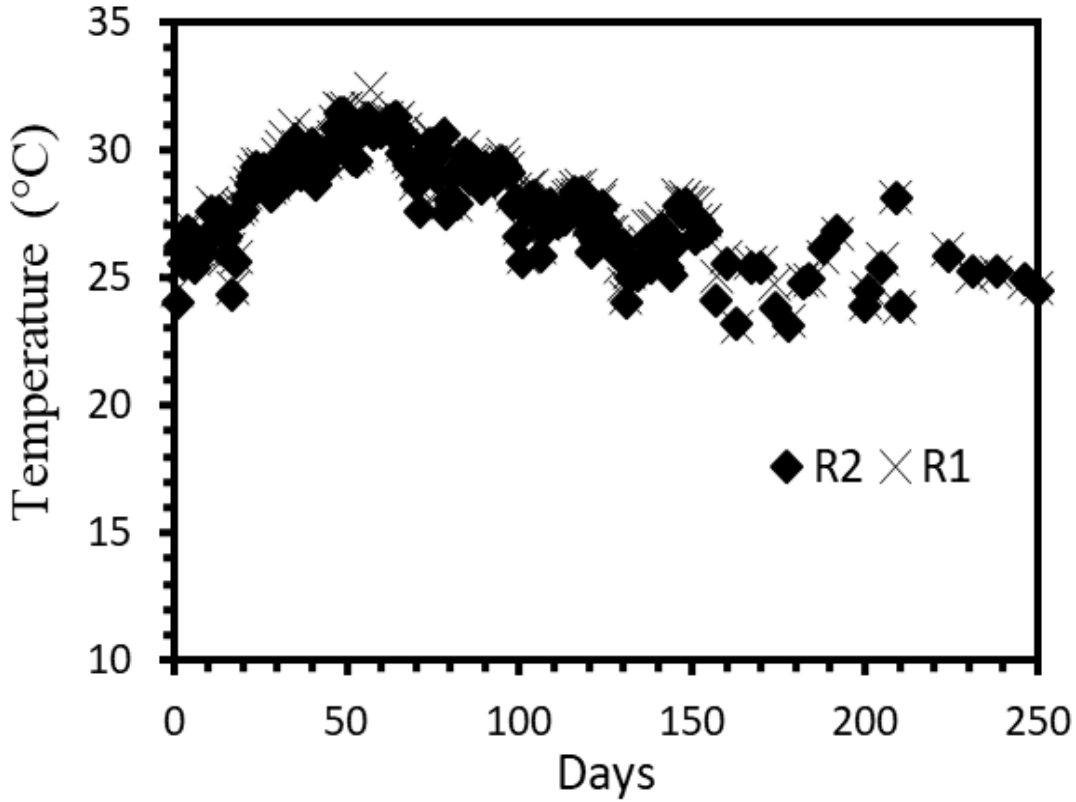


Leachate characteristics

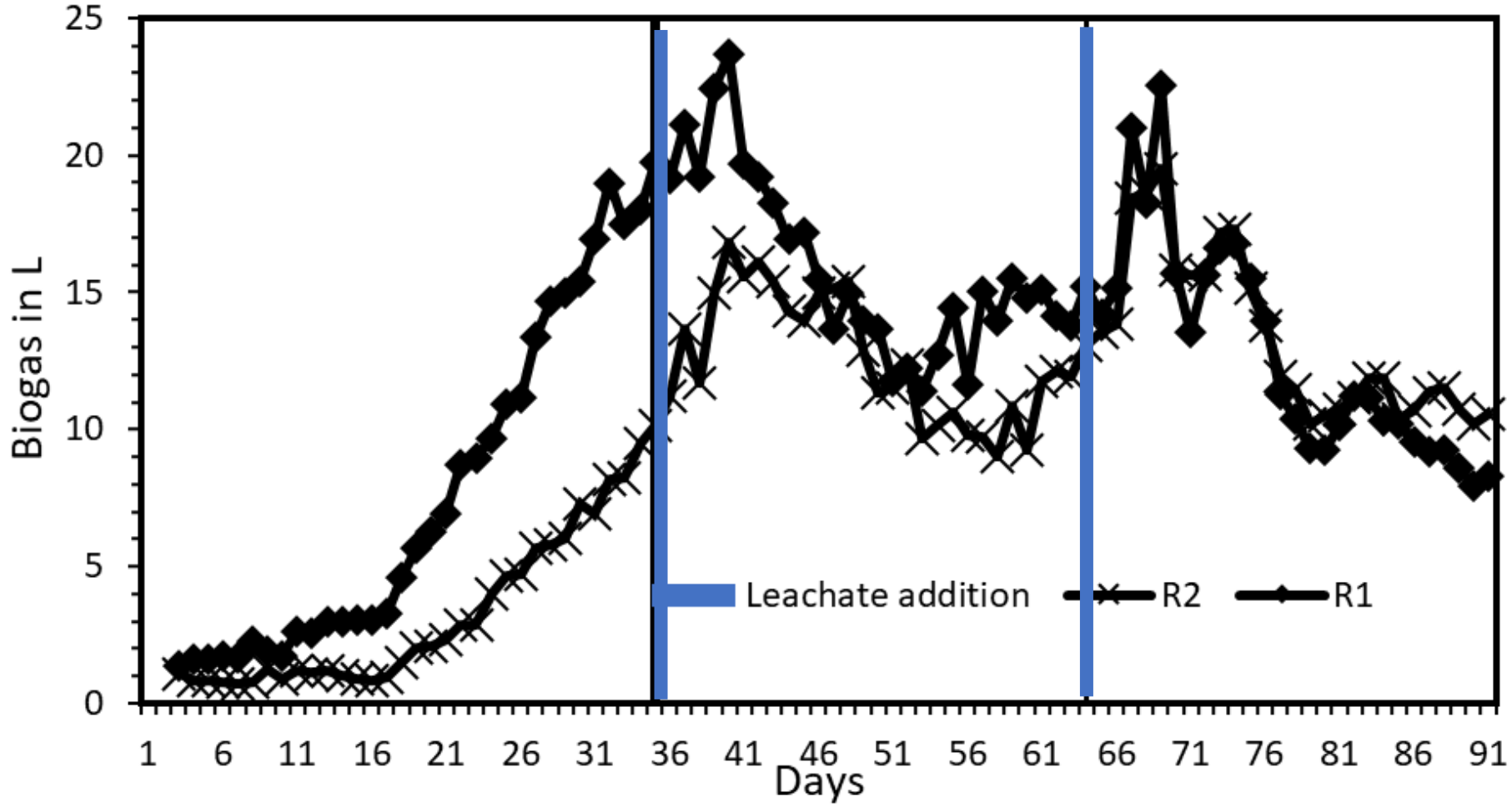
Parameter	Before recirculation	R1	R2
		After recirculation	
pH	5.65	8.49	8.05
Electrical Conductivity S/cm	33500	10660	16480
Total Dissolved solids mg/l	21558	6800	10600
Bio-chemical oxygen demand	8600	1200	5500
Chemical Oxygen Demand mg/l	26500	4000	8000
Sulphate as SO_4, mg/l	1327	49.4	90
Total Alkalinity as CaCO3, mg/l	11500	360	480

Results

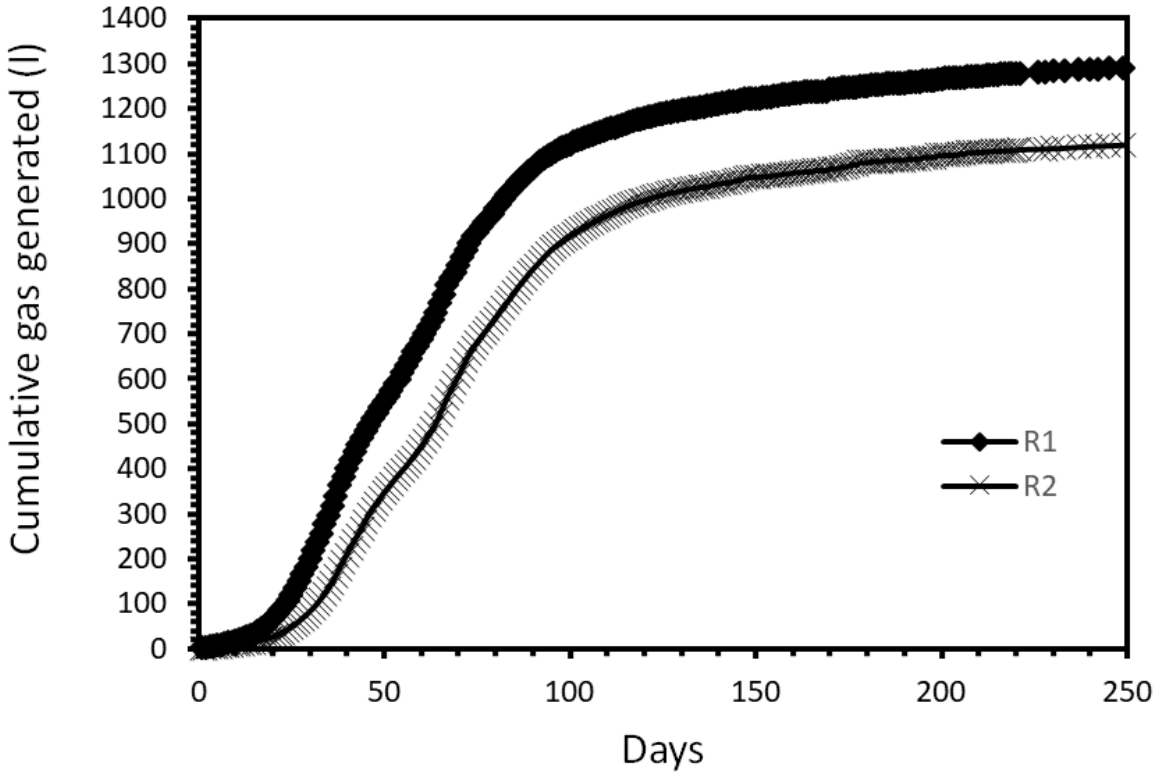

Volumetric moisture content (%)
0.8
0.6
0.4
0.2
0
50
100
150
200
250
Days
R2
R1

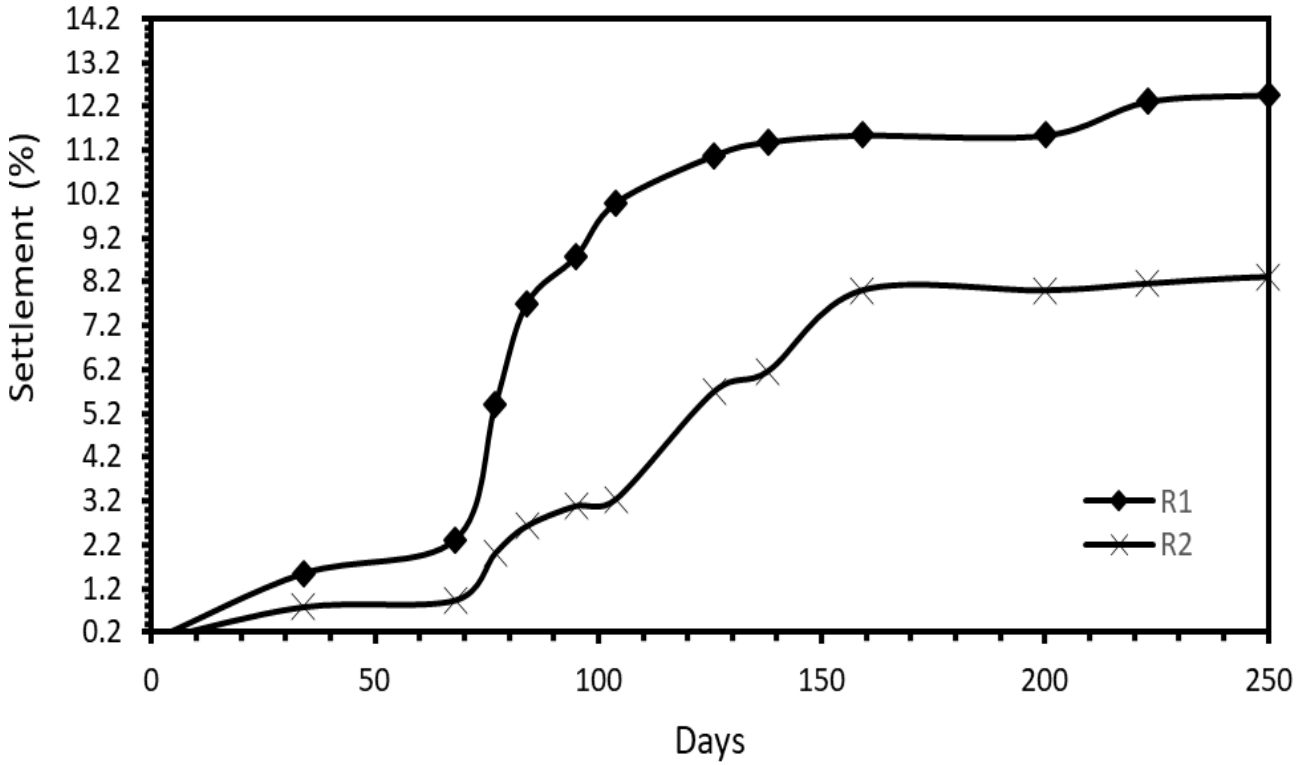

Temperature (°C)
35
30
25
20
15
10
0
50
100
150
200
250
Days
R2
R1

Daily biogas production rate



Results


Cumulative gas generated (l)
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
Days
R1
R2


Settlement (%)
14.2
13.2
12.2
11.2
10.2
9.2
8.2
7.2
6.2
5.2
4.2
3.2
2.2
1.2
0.2
0
50
100
150
200
250
Days
R1
R2

Conclusions

- Recirculating active landfill leachate in a closed landfill site is a promising solution to eliminate the leachate generated in active landfill.

- Quantity reduction, and extensive reduction in BOD, COD, total dissolved solids and heavy metals in recirculated leachate.

- Increased gas production and settlement of the closed landfill

Acknowledgement

- Funding agency -Prime minister’s research fund, Government of India

Thank you

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