Sustainable Environment

Heavy metal solubilization during the acidogenic phase of anaerobic digestion

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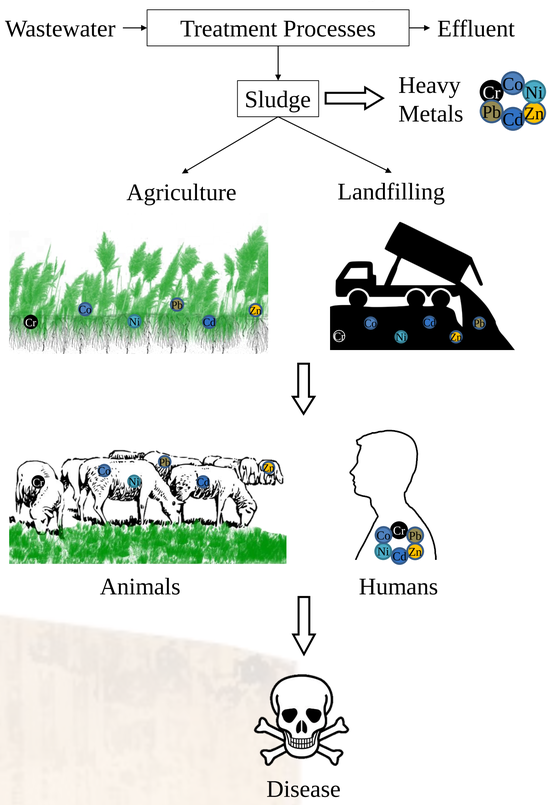
Abstract

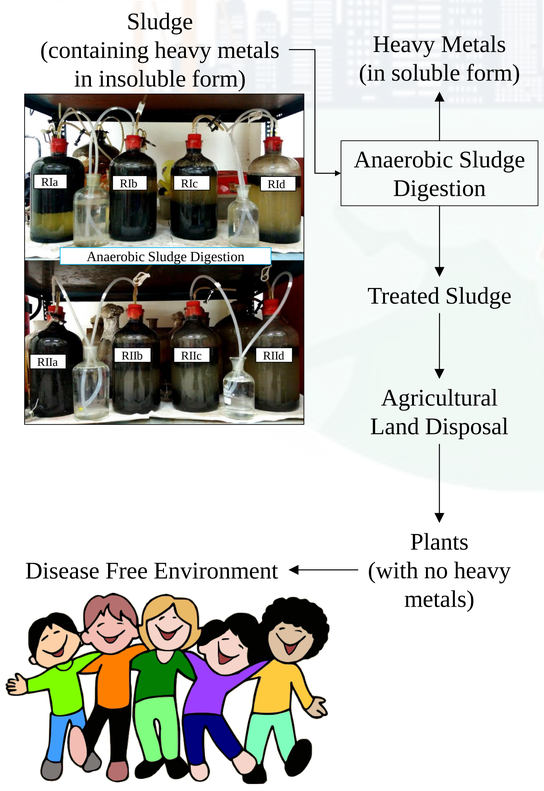
Wastewater treatment processes produce large amounts of sludge containing heavy metals that limit the use of sludge on agricultural land, and it becomes necessary to treat the sludge. Biological process such as anaerobic digestion contains acidogenic bacteria that produce organic acids during the initial phase, known as acidogenesis. These acids help in lowering the pH of the system which further aid in the solubilization of heavy metals. An anaerobic batch reactor has been used where pH dropped below 4.5, and organic acids were produced up to 1600 mg/l. This led to the solubilisation of Zn: 36 %, Pb: 25 %, Co: 28 %, Cd: 27 %, Ni: 32 % and Cr: 24 % respectively.

Introduction

Accumulation of Heavy metals



Treatment

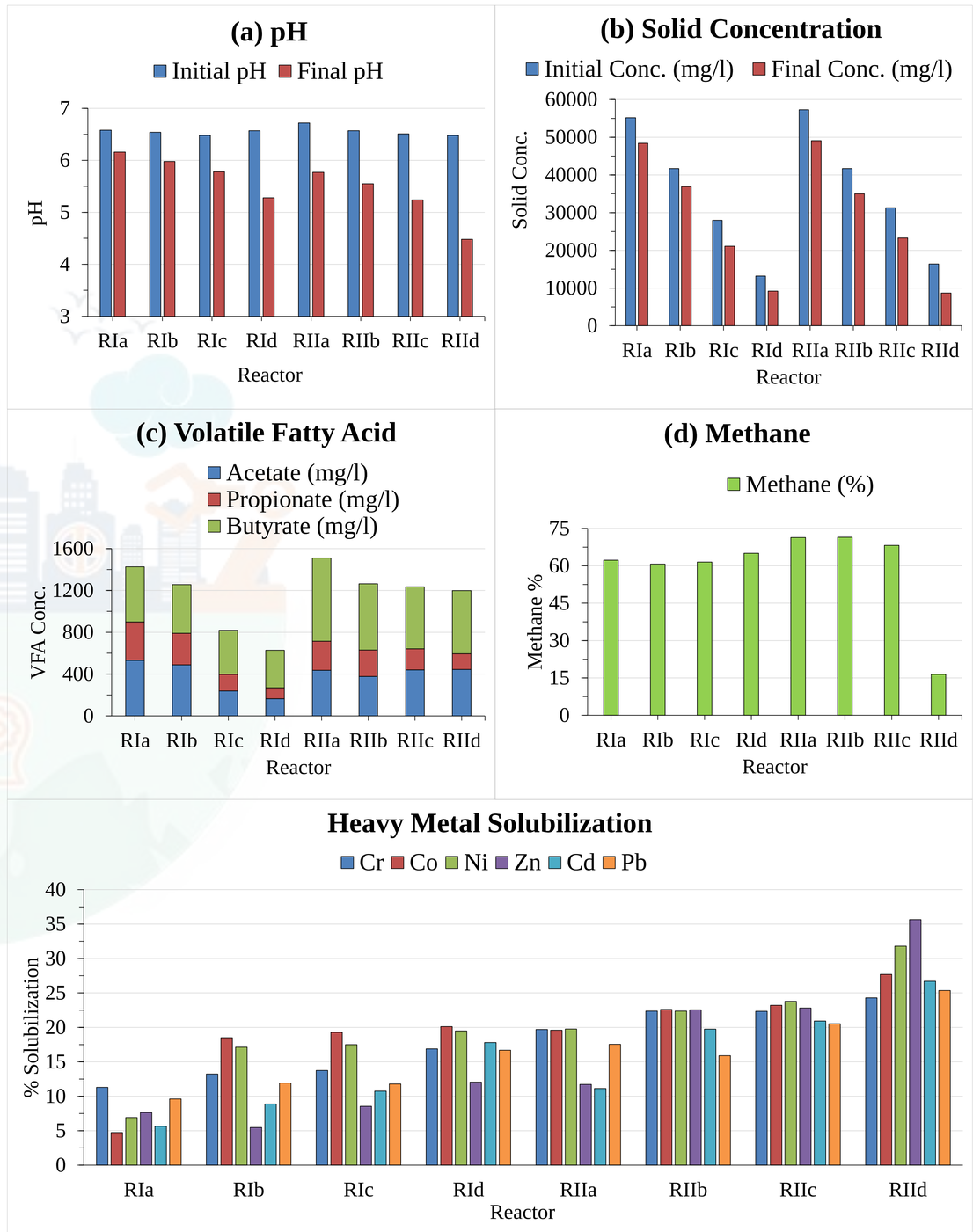


Materials and Methods

Anaerobic batch reactors with different solid concentration of sludge (Mehrauli sewage treatment plant, New Delhi, India) were used. Glucose was added as a carbon source.

Glucose Percentage	0.25% in 2l Reactor				0.5% in 2l Reactor			
Reactor	RIa	RIb	RIc	RId	RIIa	RIIb	RIIc	RIId

Result



Change in

(a) pH,

(b) solid concentration,

(c) volatile fatty acid concentration,

(d) methane production and

(e) heavy metal solubilization

during the anaerobic sludge digestion.

Conclusions

- The reduction in pH leads to the solubilization of heavy metals.
- It can be concluded that heavy metals can also be solubilized using biological process without the addition of any harmful chemicals.
- The solubilized heavy metals are now present in the leachate and can be removed from it by various other methods such as adsorption, precipitation or coagulation.

Industrial Significance

- Mining Industries, Tannery industries and other industries that produces metal wastes.
- Biological treatment processes are cost effective and environment friendly.

Technology Readiness Level:

Currently at laboratory scale (research level).

References

1. J. B. van Lier et al., “New perspectives in anaerobic digestion.,” Water Sci. Technol., vol. 43, no. 1, pp. 1–18, 2001.
2. J. W. C. Wong, L. Xiang, X. Y. Gu, and L. X. Zhou, “Bioleaching of heavy metals from anaerobically digested sewage sludge using FeS2 as an energy source.,” Chemosphere, vol. 55, no. 1, pp. 101–7, 2004.
3. Y. G. Du, T. R. Sreekrishnan, R. D. Tyagi, and P. G. C. Campbell, “Reply: Effect of pH on metal solubilization from sewage sludge: a neural-net-based approach,” Can. J. Civ. Eng., vol. 22, no. 4, pp. 839–839, 1995.

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