

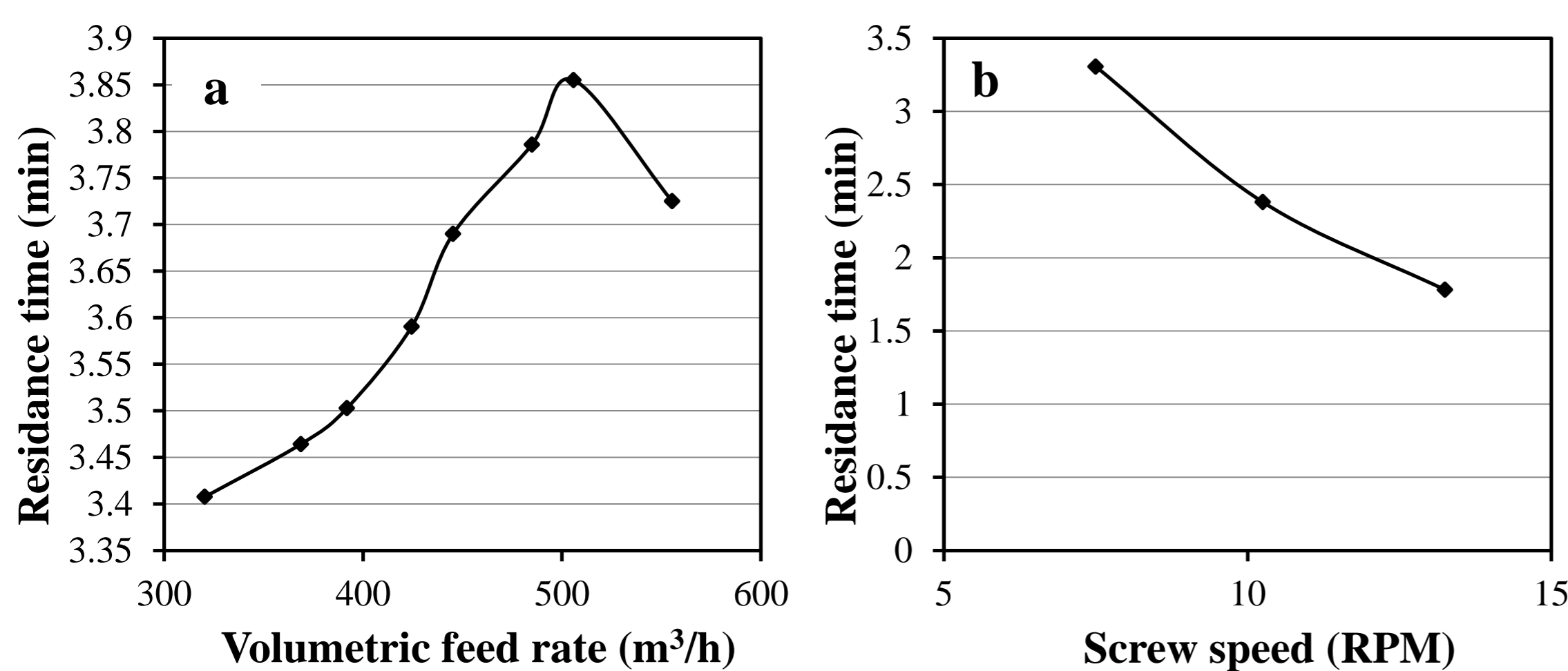
## Introduction

Low rank coal (LRC) such as lignite and sub-bituminous coal constitute around 48% of the global coal reserve. Benefits of LRC includes low mining cost, high reactivity, and low ash. On the other hand, their high moisture content, low calorific value, high transportation cost, potential safety hazards are some of the limitations of LRC. These limitations can be overcome by removing substantial amount of moisture using either thermal, mechanical, or chemical means.

## Aims and Objectives

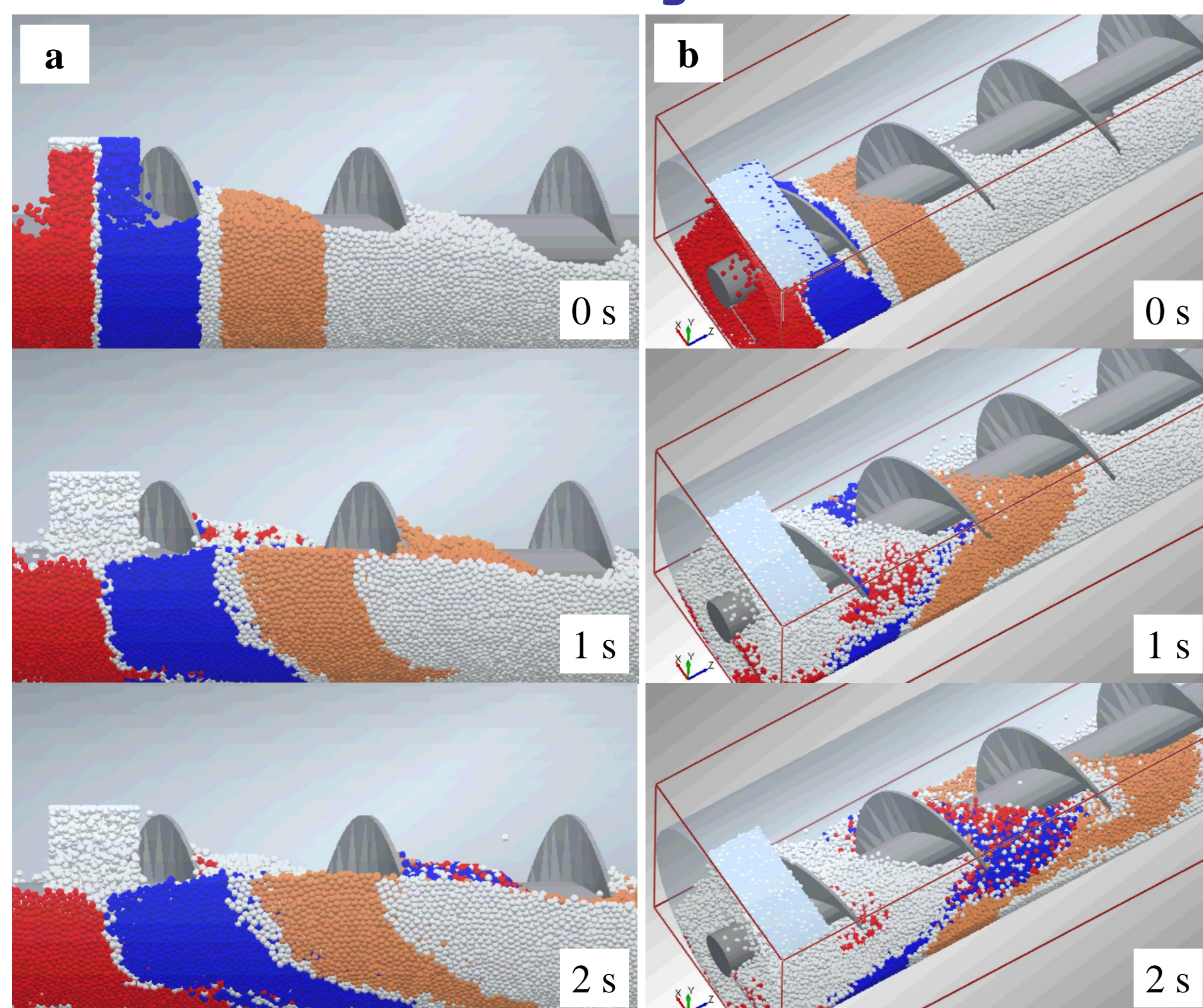
1. Performance study of indirectly-heated 150 kg/h SCD.
2. Compare SCD performance with continuous VFBD.
3. Characterization of wet and dry feed.
4. Simple mathematical modelling for scale-up.
5. Develop a cost-effective drying system.

## SCD Performance using sawdust particles



**Fig. 2** Mean residence times with respect to (a) volumetric feed rate; and (b) screw speed.

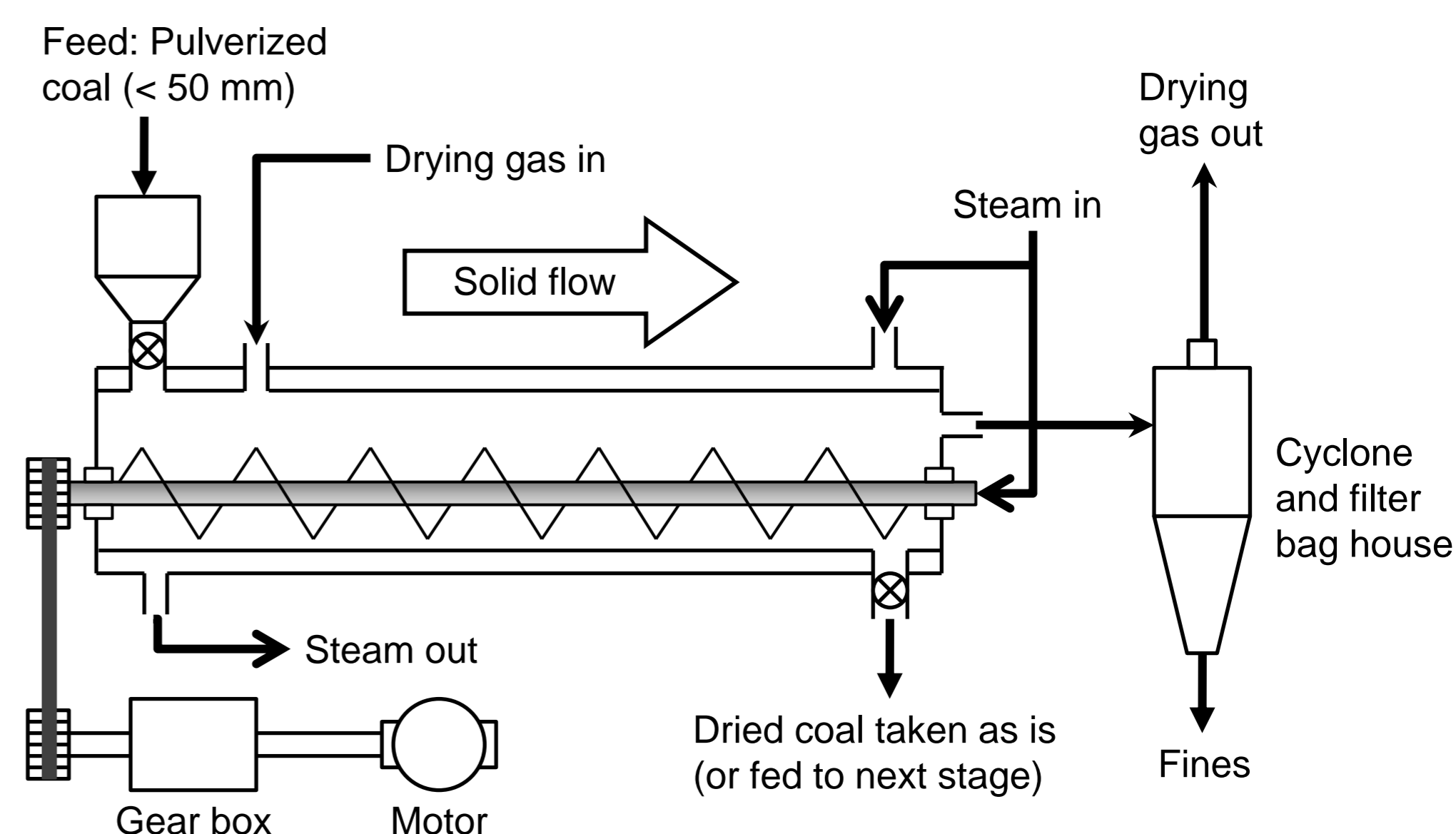
## Discrete Element Modeling



**Fig. 3** EDEM simulation portraying particle mixing for screw speed of 60 rpm, at  $t = 0, 1,$  and  $2$  s. (a) side view, (b) isometric view.

## Pilot-scale SCD

1. Heat transfer via jacket and hollow shaft;
2. Replaceable screw for three different pitches.
3. Screw: len 2.8 m, dia: 170 mm, pitch: 60, 90, 120 mm.
4. Vacuum level 20-40 mbar.



**Fig. 1** Screw conveyor dryer schematic.

## Conclusion

Mixing in screw conveyor was studied qualitatively using colored dust particles. The dust particles of same size range and density were colored with two different colors. Experimental observation reveal that the dust particles mix very well within the screw length provided at a screw speed of 7.5 rpm and a throughput of 300 m³/h.

EDEM was used to model the flow of granular material inside the SCD. For a screw speed of 60 rpm, excellent mixing was observed as shown in Fig. 3. Future modeling work includes: study of the effect of various operating parameters such as feed flow, screw speed, angle of inclination (0-15 degrees) of the trough, on the residence time distribution. Other parameter effects such as those due to changes in mass flow rates, average particle velocities as well as power consumption are evaluated for above mentioned geometric and operating variables. The objective is to utilize trends obtained from DEM studies for innovative designs of SCD.

## References

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2. Jangam, S.V., Karthikeyan, M., Mujumdar, A.S., A critical assessment of industrial coal drying technologies: Role of energy, emissions, risk and sustainability. *Drying Technology* 2011, 29(4), 395-407.

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