

# Potash lime silica glass from renewable raw materials in the system rice husk ash - eggshells - beech wood ash

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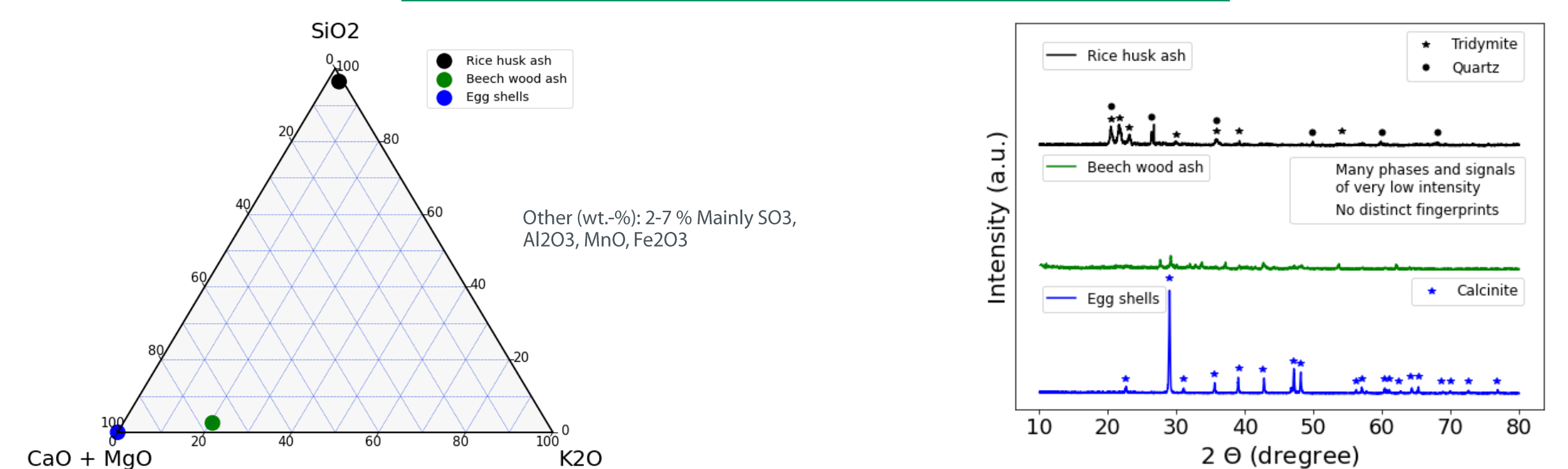
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## Motivation



- Food production generates a large amount of agricultural by-products [1]
- These wastes can also be used for glass production [2]
- Compared to synthetic raw materials, there are challenges [3]
  - Impurities and undesirable components
  - Alkali content of ashes is usually limited to 20-40 %
  - Ashes usually contain only  $K_2O$  as alkali and very rarely  $Na_2O$
- The overall aim of the work is to produce glass from exclusively renewable raw materials with properties close to those of container glass

## Raw materials

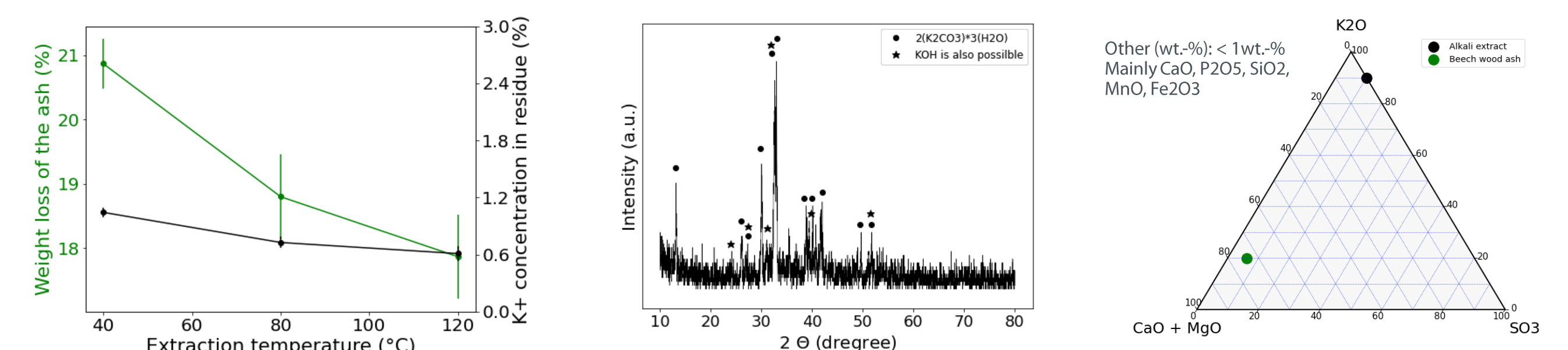


- Rice husk ash and eggshells contain mostly  $SiO_2$  and  $CaO$
- Beech wood ash is relatively low in alkali content

## Approach

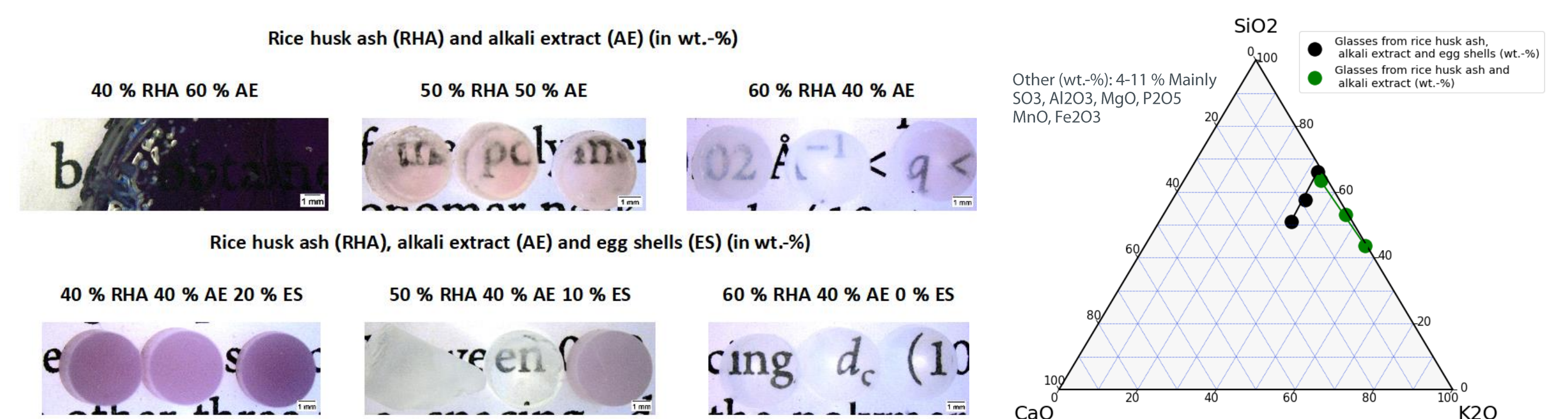
- The raw materials selected were
  - Rice husk ash (RHA) as a  $SiO_2$  source
  - Beech wood ash as an alkali source (BWA)
  - Egg shells (ES) as a  $CaO$  source
- The alkalis from the beech wood ash were extracted with water for 4 h and the alkali extract (AE) was dried
- SciGlass® was used to calculate the Littleton point. The glasses from the batch compositions are within the Littleton point range of  $< 780\text{ }^\circ\text{C}$
- Two series of batch compositions were selected
  - (x) RHA – (100-x) AE      Batch compositions are in wt.-%
  - (x) RHA – (40) AE – (60-x) ES      with x = 40, 50, 60 %
- Melting temperature:  $1450\text{ }^\circ\text{C}$  with 1 h dwell time, cooled down in the furnace

## Alkali extract



- $40\text{ }^\circ\text{C}$  is sufficient to extract alkalis from beech wood ash
- The dried alkali extract contains mainly potassium compounds

## Glasses



- All samples are in the glassy state (XRD)
- Glasses from alkali extract and rice husk are transparent and colored (MnO), the ones with eggshells got opaque

## Summary

- Rice husk ash and egg shells are relatively pure raw materials which can be adequately used as resources for  $SiO_2$  and  $CaO$
- The beech wood ash as a source of alkali contains relatively few alkalis so a chemical extraction is necessary
  - Alkalis are easily extracted with water at low temperature and the extract contains mostly potassium compounds
- All the samples are in the glassy state, but mostly colored due to presence of Mn oxide, and glasses without egg shells are transparent