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

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Abstract

Today, glass is made from widely available minerals and synthetic raw materials. In the past, however, raw materials from renewable resources were also used for glass production. One example is "Waldglas", a potash glass that was produced in forest glassworks north of the Alps from the High Middle Ages to the early modern period (1–3). Quartz sand was used as the glass former and potassium carbonate (potash) obtained from plant ash as network modifier (3).

Nowadays, there is a large amount of food and agricultural waste that is landfilled or incinerated (4, 5). The ash from many of these wastes could be used as a raw material for glass manufacturing. It has already been shown that it is possible to melt glass from renewable raw materials (6, 7).

However, for many reasons it is a challenge to produce glasses from renewable raw materials that have a certain composition and adapted properties. One major problem is that renewable raw materials often contain both undesirable and desirable oxides. For SiO₂ and CaO, there are raw materials with high purity, for example eggshells and rice husk ash (6). Raw materials for alkalis, on the other hand, often contain only about 20-40 % alkali oxides (8). This limits the achievable glass compositions. Other problems are the fluctuating chemical compositions of raw materials, impurities and the locally varying availability of raw materials. In addition, the characteristics and properties of glass made from renewable raw materials are not well explored and there is no safe alternative to soda lime glass made from renewable raw materials.

The aim of the work was to produce a glass from renewable raw materials that has comparable properties to soda lime glass. The composition is in the range of 74-16-10 wt.% SiO₂-K₂O-CaO. The raw materials are rice husk ash as SiO₂ source, eggshells as CaO source and beech wood ash as K₂O source. Since beech wood ash contains only about 40 wt.% alkali oxides, this raw material was pre-treated separately. The ash was thermally and chemically pre-treated and the alkalis were extracted. The alkalis for the glasses produced came wholly or partly from an extract of the beech wood ash. Various thermal and chemical pre-treatments were used for the beech wood ash. The glasses were characterized and compared with soda-lime glass.

With the help of the chemical extraction of potassium from the ash, other indigenous renewable raw materials can be used as alkali sources. This makes the formulation more flexible

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and transferable. Since eggshells and rice husk ash are also very pure raw materials, it is easier to set a specific chemical composition of the glass. It also improves the reproducibility of the glasses made from renewable raw materials.

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