From sand to bottle: Assessment of silica sand deposits in Northern Namibia for glass-related value chains

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INTRODUCTION

Glassware is an essential product in our daily lives and glass manufacturing is a vital industry for the economy of any developing country. However, there is currently no established upstream and downstream glass industry in Namibia. Glass articles consumed in Namibia are imported from other countries. In line with Namibia's Growth at Home strategy, establishing a glass industry could contribute substantially to increasing the value of minerals and as well as job creation. Silica sand occupies a major share of the total raw materials used to manufacture glass. The communal lands of northern Namibia are endowed with abundant silica sand resource; these are currently being extracted in numerous locations for construction purposes, brickmaking or to access ground water. A reconnaissance and sampling field programme in the northern part of Namibia took place in 2021 to assess silica sand deposits and their potential for further mineral beneficiation with specific focus on the container glass industry, highlighting opportunities to create new local value chains.

INDUSTRY SPECIFICATIONS FOR SILICA SAND IN GLASS PRODUCTION

Depending on the type of glass products to be made and their colour, the industry enforces strict requirements on the silica sand raw materials. To be suitable for producing float glass, there must be a very high proportion of silica (SiO_2 above 99%) in the composition of the silica raw material[1]. Clear as well as coloured container glass production requires a silica content above 98%. Any contaminants[2] such as unfavourable heavy minerals (e.g. chromite, zircon, kyanite etc.), humic substances, carbonate and soluble salts are unwanted. The acceptable content of colouring oxides (Fe_2O_3, TiO_2, and Cr_2O_3) in the sand raw materials also varies, depending on the type and colour of the glass to be produced[1]. For all types of glassware, the TiO_2 content should be less than 0.03%. To produce clear container glass, the content of Fe_2O_3 and Cr_2O_3 should be below 0.03% and 0.001% respectively while float glass production requires a content of Fe_2O_3 and Cr_2O_3 less than 0.05% and 0.02% respectively. With respect to graining, 95% of the bulk sand fraction must be in the range of 0.15 - 0.6 mm[1]. Apart from the grain size, the grain morphology also plays a role when it comes to melting behaviour of the sand grains. For container glass production, angular grains are preferred[3].

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SAMPLING AND ANALYSIS

In total, 23 active and abandoned sand mining sites in the northern part of the country were visited, described and sampled during a field campaign in 2021, where 38 silica sand samples were prepared and analysed for whole rock geochemistry of major and trace elements by X-ray fluorescence (XRF) and mineralogical identification by X-ray diffraction (XRD). Furthermore, grain size distribution and grain morphology were detected through Camsizer.

RESULTS AND INTERPRETATION

Laboratory assay results show an average SiO_2 content of 98.9% with the majority of the samples containing > 99% SiO_2, qualifying them for various glass-making industries. XRD results confirm that the SiO_2 is purely present as quartz. The (un-processed) raw material contains on average 0.12% Fe_2O_3, which is too high for clear container glass production but well in line with requirements for coloured container glass. The unprocessed samples furthermore contain 0.06% TiO_2 and less than 11 ppm chromium (Cr). Only eight of the samples show a TiO_2 content compatible with the above-described industry specifications. It has yet to be confirmed whether the TiO_2 content of the remaining samples as well as the Fe_2O_3 content of all samples can be reduced during processing (washing, magnetic separation etc.) for the sand raw material to be suitable for all of the mentioned industrial applications. Other colour-inducing trace elements (Mn, Cu, Co etc.) seem to be within limits (content below detection limit). Most of the samples meet the required bulk grain size range of 0.15 to 0.6 mm[4] for container glass production. Any grain size fractions above or below the desired size range can easily be separated during screening processes. Grain morphology proves to be more on the angular side, which is favourable for ideal batch melting conditions.

CONCLUSION

This investigation suggests that several silica sand deposits in the northern part of Namibia may not only be suitable for construction purposes and brick making, but may be promising candidates for further beneficiation in the glass production industry. This beneficiation of Namibian mineral resources would boost the economy and create numerous jobs for local communities. Additional environmental (especially related to groundwater), social and economic (e.g. resource estimation) issues still need to be addressed and investigated before identifying the most promising silica sand deposit for glass production.

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I have been an employee of the Ministry of Mines and Energy since 2016 as a Geoscientist within the Economic Geology Division, Department of Geological Survey.

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