Challenges associated with sucrose crystallization in processing of low-quality sugar beet

Processing low-quality sugar beet presents complex challenges to sucrose crystallization, primarily due to elevated levels of non-sucrose impurities such as organic acids, amino compounds, inorganic salts (e.g., K^+, Na^+), and sometimes microbial polysaccharides like dextrans. These impurities reduce raw juice purity and increase viscosity, leading to difficulties in clarification, filtration, and evaporation. During crystallization, they narrow the metastable zone, inhibit nucleation and crystal growth, and contribute to higher sucrose losses in molasses.

Moreover, interactions between amino compounds and reducing sugars promote Maillard reactions, longer crystallization batches resulting in increased crystal coloration and reduced product purity. Consequently, the presence of these factors in low-quality beets not only lowers the crystallization yield but also deteriorates the overall quality of the sugar crystal and molasses produced.