CHAPTER · VIII

CONCLUSIONS
CONCLUSIONS

In present investigation, sucrose hydrogenolysis was carried out in presence of a number of additives. Among hydroxides, Ca(OH)$_2$ was an effective promoter inducing maximum glycerol and ethylene glycol formation. NaOH yielded only ethylene glycol (25%) to an appreciable extent. KOH at 3.5% concentration, appeared to produce 21% propylene glycol by sorbitol hydrogenolysis although some glycerol and ethylene glycol were also formed at its concentration range of 0.5-1.25%. All the hydroxides appeared to promote hydrogenolysis via chelate formation [36-37].

The dissociation of metal carbonates in their aqueous solution played a vital role in sucrose conversion. Na$_2$CO$_3$ seemed to be effective additive for enhancing glycerol yield. Appreciable ethylene glycol and propylene glycol were found in the presence of Na$_2$CO$_3$ only. It is interesting to note that CaCO$_3$ at lower concentrations, promoted the conversions of glycerol and ethylene glycol whereas Na$_2$CO$_3$ promoted the conversions of glycerol and ethylene glycol at concentrations higher than 3%.

Amines were found to inhibit sucrose hydrolysis due to the presence of OH$^-$ ions in their aqueous solution, on the other hand they appeared to promote the hydrogenolysis of sucrose. n-butylamine was the most effective amine for the production of glycerol and glycols. n-Butylamine appeared to
weaken $C_3 - C_4$ bond of glucose formed as a result of sucrose hydrolysis increasing glycerol yield to 36%.

Chlorides of aluminium, zinc and iron produced $H^+$ in their aqueous solutions. The ions catalysed sucrose hydrolysis. $\text{FeCl}_3$ and $\text{AlCl}_3$ were also found to promote glycerol formation by the hydrogenolysis of monosaccharides and sorbitol. However $\text{AlCl}_3$ can not be recommended for sucrose hydrogenolysis because it causes a violent reaction in its aqueous solution. It also tends to corrode the reactor. Interestingly $\text{ZnCl}_2$ promoted ethylene glycol conversion to some unknown compound at its concentration range of 1.5-4.5% whereas propylene glycol conversion to some unknown compound was noticed with $\text{AlCl}_3$ in the concentration range of 4.5 to 9%.

Metallic salts formed hydrates in their aqueous solutions and $H^+$ ions thus released, promoted sucrose hydrolysis. With sulphates of copper, nickel & zinc, the ethylene glycol was found to convert into some unknown compound. Sulphates of iron, copper and zinc produced good yield of glycerol. A pair of 3% $\text{FeCl}_3$ & 9% n-butylamine was observed to be the most effective combination of the additives in enhancing glycerol yield. The achieved glycerol yield was 45%.

It was found that molasses can be a cheaper alternative to sucrose for hydrogenolysis to produce polyols, if
its $K_2CO_3$ content is completely removed or minimised to the least possible extent and its $Na_2CO_3$, $CaCO_3$, $MgCO_3$ and $Fe_2O_3$ contents are maintained at 2%, 3.5%, 15% and 0.5% respectively.

First order kinetics was found to prevail during sucrose hydrogenolysis in presence of n-butylamine, the additive yielding maximum glycerol amount. Activation energy of sucrose conversion was found to be 32.44 Kcal/gm mole.

8.1 **Scope for further research work:**

The catalyst used in the present study, deactivated in the presence of various additives perhaps due to some physico-chemical degradation. The exact mode of deactivation is not known and can be investigated in a further study.

Chelation appeared to be a cause of enhanced glycerol formation during sucrose hydrogenolysis in the presence of hydroxide, carbonate, amines & zinc chloride. A study may be undertaken to verify the occurrence of chelation and to find out exact mechanism of chelate induced hydrolysis.

The fructose yields were lower than the glucose yields during sucrose hydrogenolysis in the presence of lower concentrations of Lewis acids. The situation reversed at the higher concentrations. The exact reason of this phenomenon is unknown and is proposed for further investigations.
Some unknown compounds were formed during sucrose hydrogenolysis. Their identification may also be a part of further study. The study on the effects of various process variables on hydrogenolysis of molasses after its processing as suggested in the present work, may be undertaken in a further study.

*******