SUMMARY
Brass alloys find their use for various applications such as electrical wiring, hardware, connectors, printing circuit boards, valves, screens, tanks, heat exchangers, engine parts, propellers, air conditioning and refrigeration, artificial jewellery, statues, decorative items, industrial and chemical plants process equipment. The brass alloys come in contact with various organic and inorganic chemicals depending upon their use and applications and are subjected to corrosion as well as dezincification. Oxidizing acids are highly corrosive towards brass alloys. In this manuscript, investigations have been reported for controlling the corrosion of 70/30 brass alloy in 3N HNO₃ solution with the help of various corrosion inhibitors such as cocobetaine, hydrazine hydrate, benzalkonium chloride, trimethyl octyl ammonium chloride, myristyl dimethyl benzyl ammonium chloride, ortho-1,3,4-thiadiazole. The thesis consists of eight chapters, which have been summarized below.

In the First chapter of the manuscript introduction of the research topic has been described in detail. Corrosion phenomena and its importance, electrochemical theory of corrosion, polarization, forms of corrosion, corrosion preventive methods have been briefly discussed. Corrosion inhibitors, their classification and mechanism of inhibition along with various absorption isotherms have been described in detail. Corrosion and dezincification phenomena in brass alloys have been discussed with special emphasis on brass corrosion in nitric acid. An account of various factors which are important for
inhibitors to provide a high efficiency have been given. An exhaustive literature survey of corrosion inhibitors to control the corrosion of copper and brass alloys has been described. In the end of the chapter aims of the present work have been elucidated.

In the Second chapter of the manuscript, details of materials used for the experimental work and the methods adopted for the preparation of specimen have been reported. Weight loss method, polarization technique, linear polarization technique, scanning electron microscopy and atomic absorption spectroscopy used for performing the experiments have been discussed in detail.

In the Third chapter of the thesis the results of the experiments carried out using cocobetaine as inhibitor have been reported and discussed in detail. Mechanism of corrosion of 70/30 brass in nitric acid has been described and various corrosion parameters like percentage inhibition efficiency, optimum concentration of the inhibitor, corrosion current density, corrosion rate, percentage inhibition efficiency towards Cu and Zn separately and heat of adsorption of the inhibitor have been evaluated. Inhibition efficiency decreases with increase in temperature of the corroding system and increases with increase in concentration of the inhibitor. The inhibitor acts as a mixed inhibitor though it predominantly suppresses the cathodic reaction. Langmuir adsorption isotherm governs the adsorption of the inhibitor molecules on the brass
surface up to the optimum concentration of the inhibitor. Adsorption of inhibitor molecules on the surface of brass occur through the carbon of the carboxylic group in the inhibitor molecule. Cocobetaine shows a very high efficiency for the corroding system and can be industrially exploited easily.

In the IV chapter of the manuscript, the results of hydrazine hydrate as corrosion inhibitor for 70/30 brass in 3N HNO₃ acid solution have been reported. Hydrazine hydrate molecule is protonated giving positive charge over any of the nitrogen atoms in the molecule and it is adsorbed on the surface of brass through this nitrogen. Hydrazine hydrate may combine with nitrous acid to give hydrazoic acid which further results in formation of N₂ when reacts with nitrous acid. Hydrazine hydrate also provides a high inhibition efficiency towards the corroding system and acts as a mixed inhibitor. Optimum concentration of the inhibitor has been found to be 200 ppm and inhibition efficiency decreases with increase in temperature of the corroding system. Inhibition efficiency linearly increases with increase in the concentration of the inhibitor up to 200 ppm concentration and then remains almost constant.

The results of benzalkonium chloride as inhibitor in the corroding system have been reported in chapter V of the manuscript. Benzalkonium chloride provides a very high efficiency and is an excellent inhibitor. It suppresses both anodic and cathodic reactions and shows high efficiency even at 100 ppm concentration at 20°C and 30°C. Benzalkonium
chloride is chemisorbed on the surface of brass at 200 ppm concentration. Benzalkonium chloride is protonated in nitric acid solution and interacts with the brass surface through p\(\pi\) orbitals of the phenyl ring and d\(\pi\) orbitals of metal atoms. Here also the percentage efficiency decreases with increase of temperature and increases with increase in concentration of the inhibitor. Langmuir adsorption isotherm is applicable for the adsorption of benzalkonium chloride molecules on the brass surface.

In Chapter VI, investigations of trimethyl octyl ammonium chloride as inhibitor for 70/30 brass in 3N HNO\(_3\) solution have been described and discussed. Efficiency of this inhibitor is not as good as reported for the inhibitors in the preceding chapters. Trimethyl octyl ammonium chloride acts by way of adsorption on the surface of brass and is chemisorbed over the surface of brass. Adsorption of the inhibitor occurs through N atom in the molecule but N is sterically hindered and thus the possibility of its attachment to brass surface decreases. This is the reason that trimethyl octyl ammonium chloride shows a lower inhibition efficiency. Langmuir adsorption isotherm equation is applicable upto 300 ppm concentration of the inhibitor.

Myristyl dimethyl benzyl ammonium chloride as corrosion inhibitor for 70/30 brass in 3N nitric acid solution has been described in chapter VII of the manuscript. It is also a good inhibitor and provides high efficiency at all the temperatures investigated. 200 ppm is the optimum
concentration of the inhibitor and the inhibitor, myristyl dimethyl benzyl ammonium chloride acts as a mixed inhibitor, Langmuir adsorption isotherm is applicable only upto 200 ppm concentration of the inhibitor. It seems that the inhibitor is physically adsorbed over the surface of brass through delocalized \( p\times \) orbitals present in the inhibitor molecule. Scanning electron micrographs of the corroded surface in presence of the inhibitor also reveals the presence of surface film of the inhibitor molecules on the surface of brass.

The results of ortho-1,3,4-thiadiazole have been reported in chapter VIII of the manuscript. This inhibitor does not provide very high efficiency towards the control of corrosion of 70/30 brass in 3N nitric acid solution. 200 ppm is the optimum concentration of the inhibitor where maximum efficiency is observed. The inhibitor is a mixed type inhibitor suppressing both cathodic and anodic reaction. However, the inhibitor has more tendency to control the hydrogen evolution reaction. Percentage efficiency decreases with increase of temperature. Langmuir adsorption isotherm governs the adsorption mechanism of the inhibitor over the surface of brass upto its optimum concentration.

Atomic absorption spectroscopy and weight loss experiments have revealed that when 70/30 brass is exposed to 3N \( \text{HNO}_3 \) solution dezincification does not occur at all and only general corrosion of brass takes place. Based on the results of all the investigated inhibitors, they can be graded
according to their percentage inhibition efficiency to control the corrosion of 70/30 brass in 3N HNO₃ solution as given below.

Cocobetaine > Hydrazine hydrate > Benzalkonium chloride > Myristyl dimethyl benzyl ammonium chloride > trimethyl octyl ammonium chloride > ortho-1, 3, 4-thiadiazole.