CHAPTER I

INTRODUCTION

Rice has been cultivated in India since ancient times and is very closely associated with the life and dietary habits of a vast number of people in India as it is the main source of their nutrition. India with about 40 million hectares of land under rice, is the second largest rice-growing country in the world, producing about 70 million tonnes of paddy - the production being second to that of China with a production of 91 million tonnes.

Rice milling is the biggest agro-based industry of India representing 22 per cent of its national income. It comprises about 80,000 rice mills, each with a capacity varying from half to four tonnes per hour. The milling equipment in about 95 per cent of them is traditional while it is improved or modern in the rest. The paddy processed through the mechanised rice milling industry in the organized sector is estimated to be nearly 70 per cent, the remaining 30 per cent being hand-pounded apart from annual requirement of seed.

The traditional mechanized mills use chiefly Engelberg type hullers and under-runner disc shellers in combination with paddy separators and cone polishers. There are also establishments having sheller-cum-huller combinations where huller is used for polishing. The average yield of rice varies from 62 to 68 per cent in the disc sheller mills and about 5 per cent less in the huller type mills while it is possible today to obtain 72 to 74 per cent yield of better quality rice by using modern equipment.

As the rice industry plays a vital role in the economy of the country, increasing attention has been paid to its organization and improvement. There are records to show that improvements in rice processing were suggested as early as 1940. The Government of India promulgated Rice Milling Industry (Regulation and Licencing) Act, in 1958 and rules thereof in 1959 to regulate the growth and operation of rice mills. It was further ammended in 1968 and rules thereof in 1970 laying down conditions regarding improvements to existing machinery, replacement of the traditional equipment by modern one with a view to eliminating waste, obtaining maximum rice outturn and improving the quality of milled rice.

A committee set up by the Government of India, in 1969, on the estimation of losses in processing and storage of grains estimated the loss at about 10 per cent. Brown (7) stated that the grain losses occurring during rice milling are more than in any other processing operation including harvesting. It has, therefore, been considered worthwhile to explore possibilities of increasing the efficiency of milling industry by reducing the losses and by improving grain quality. The losses in milling mainly occur at the rice polishing or whitening stage. In this polishing process, bran forming an integral part of rice grain is removed from the surface by scratching and/or rubbing. The rice grain, being brittle in nature, breaks heavily in this process, if not handled properly. Larger brokens get further reduced in size to finer ones which tend to be carried away along with bran causing reduction in overall outturn of rice. The problem of breakage of grain is further aggravated by improper grain moisture and temperature and humidity conditions at the time of milling as reported by Autrey (1), Kunze (22) and Pominsky (30). Apart from the above-mentioned factors, there are many others related to the rice polisher itself, such as machine design and operational factors which seem to affect the total and head yields of rice and the energy requirement in polishing.

It may, therefore, be stated that the rice polishing process is affected by three sets of factors, viz., grain factors, machine factors and environmental factors. As already stated, the effects of some of them have been reported by many workers and are well known. The information on the rest, especially on the machine factors, is meagre and whatever is available is not well understood. Therefore, a research project for the study of rice polishing phenomenon in abrasive polishers was undertaken with a view to studying the effect of some of these factors while laying more emphasis on the machine ones.

Rice polishers, used in India, are basically of two types viz., friction type and abrasion type. Friction type machines have metallic polishing rollers which remove bran by rubbing action under relatively high pressure of the order of

500 g/cm^2 while the abrasion types do it by cutting off the surface layers of grain by sharp abrasive particles such as emery or carborundum and separating it under comparatively low pressure of about 200 g/cm^2. Among the two types of abrasive polishers used in India - conical and cylindrical - the former one is very popular. While the cone polishers use course emery of the order of 14 to 20 mesh, the cylindrical ones use emery as fine as 40 mesh. Their operational speeds also are different. Due to these variations, the performance of these polishers is bound to vary. It has been the experience of millers of India that cone polishers perform better on Indica rice varieties while the cylindrical ones with fine emery have been found working satisfactorily on Japonica. There are no authentic studies or reports to explain the above facts, at least in India. One tends to think on the basis of the reports that the varietal difference is the main cause of the variation in the performance but it could be due to various other reasons stated above. However, due to the varying action of the polishing elements, the quality of rice, the quality of bran and the energy requirement of the machines vary. This led to the formulation of the problem of studying the action of polishers.

The present investigation was confined to the study of the abrasive polishers only the aim of which is to find out the relationships of abrasive grain size, speed of polishing wheel and pressure in the polishing chamber with the degree of polish, breakage and energy requirement. Rice polishing experiments were conducted on four varieties of raw rice viz. IR-8, Jaya, Dular and Patnai-28 with the Satake laboratory testing polisher to establish the above-mentioned relationships. They were later verified with regard to commercial prototype polishers viz. Satake MP-7 polisher and Dandekar cone polisher.

The study of rice polishing process was also undertaken on the basis of an abrasive wear phenomenon. Wear rate equations for engineering materials were suitably modified to predict the wear rate of rice by emery grain, i.e. the rate of removal of bran by evaluating and using the abrasive wear coefficient. A prediction equation relating the energy requirement in polishing to the speed of the polisher, emery grain size and pressure in the polishing chamber has also been formulated on the basis of data obtained from laboratory polisher. The values of the constant and the exponents have been evaluated for rice and emery combination. The validity of the energy equation was verified with regard to two prototype polishers.

Literature available on the rice polishing was reviewed and classified under suitable headings. Considerable work has been done to estimate the degree of polishing of rice the world over. All the chemical, physical and optical methods of determination of polish were reviewed and are included in chapter II. A portion of this chapter also gives an account of the various polishers currently used in the rice processing industry. Work related to the effects of various parameters on rice polishing phenomenon has been reviewed and presented in a classified form.

Development of abrasive wear equation on the basis of basic adhesive wear theory and the relationship of various factors with the energy requirement has been dealt with the in the next chapter. The problem and plan of experiments have been worked out involving different treatments of the dependent and independent variables. The procedures of determination of various parameters under study and the instruments and equipment used for the same have been described in detail in chapter IV.

Results of the experiments have been presented in tabular as well as graphical form, the latter showing the relationships of the parameters under study in chapter V. Their variations with respect to others have been discussed giving suitable explanation.

Lastly, certain conclusions were drawn from the work in the light of the objectives of the investigation and have been presented in the chapter on conclusions. They have also been stated briefly in the summary of the thesis.