CHAPTER - I

INTRODUCTION
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The word 'Ceramic' is derived from the Greek word 'Keramic' which originated from ancient Greek word 'Kemaros' which meant a burnt stuff (Sist, 1981). Moreover, ceramic is a term that was originally applied to the products made from natural earths that had been exposed to high temperature (Singer and Singer, 1979). In other words, ceramics are non-metallic inorganic materials that have been subjected to heat treatment. It can be considered a work of art made from clay with or without the addition of other nonmetallic inorganic materials, which are first shaped and modelled when in plastic state and subsequently fired to give the end product of desired strength. In the United States of America, the cement lime, glass and enamel industries are included among the ceramic industry, whereas in European countries they are not included as ceramic industries (Bose, 1979).

History of ceramic materials is the history of human civilization. Historians have relied heavily on ceramic articles in tracing the development of ancient civilizations as well as the migration of people. For example, the various historical eras of Mesopotamia, Persia, Egypt and India have been characterized by the ceramic pottery pieces that have been discovered (Enc. Americana, 1976).

Making of earthenwares is one of the oldest human crafts and, over the centuries, different techniques and styles have
been developed in different parts of the world. With the industrial revolution and development of technology, the production and use of ceramic materials grew rapidly. Since the raw materials, such as clay and other nonmetallic materials used for ceramic industry, are available in abundance in the crust of earth in most regions of the world, the ceramic factories are existing in countries all over the world. In the last few decades ceramic industries have developed at a very rapid pace.

At present, ceramic industries produce a wide range of articles like crockery, decorative pieces, sanitarywares, roof-tiles, refractories, insulators and many types of miscellaneous articles. The estimated figures show that nearly 7.2 million people in the world are dependent directly or indirectly on the ceramic product manufacturing or trade.

In India, a large number of ceramic factories have grown mainly as small-scale factories under unorganized sectors in various parts of the country. According to the 1976 Survey Report, there are 871 ceramic units in India, out of which 76 are in Gujarat State (Bist, 1981). However, according to the Directory of Ceramic Industries, 326 ceramic factories are existing in Gujarat State (Raju, 1976). From this it can be assumed that there are many small-scale ceramic factories existing in India which are not taken into account. In Gujarat, out of 326 units, only 6 units are included in the large and medium scale categories, the remaining being considered as small-scale factories.

The estimated average of daily number of workers employed in factories in India and Gujarat State, in the year 1979,
were 65,25,000 and 5,89,000 respectively. The estimated average of daily employment in structural clay product industry in India in the year 1979 was 1,03,000 (Labour Statistics, 1981). The employment in organized sectors of ceramic industry is shown in Fig.1. This figure indicates that the employment in ceramic industry is in increasing trend and in the year 1979 it was about 45,000. It is difficult to estimate the total average employment in small and unorganized sectors of India, as the workers are employed as casual labour on daily wages, and most of them are not on permanent basis. Even then, the estimated figure showed that 1,32,000 workers are employed in ceramic factories in India. In Gujarat State, about 22,000 workers are employed in the large and small scale ceramic factories. Moreover, so many casual workers are also engaged in ceramic production. Among the workers engaged in ceramic factories 40% are women.

In primitive and early times clay was the only raw material for pottery making. In modern ceramic products, varieties of raw materials are used depending upon the quality of the product to be manufactured. The basic raw materials without which the ceramic body and glaze cannot be possible are clay (Ball clay, Fire clay and China clay), feldspar, quartz and calcite. China clay or Kaolin forms the foundation; ball clay gives the plasticity to the desired extent which helps in modelling the wares and retaining the shapes of the wares; fire clay provides kiln pot to fire the green ceramic wares up to the desired temperature (Mc Graw Hill, 1977). Feldspar is used because it is readily fusible and works as a good flux in high temperature glazes. Calcite is a mineral which gives whiteness to the
FIG. 1

TOTAL DAILY AVERAGE EMPLOYMENT IN ORGANIZED SECTOR OF CERAMIC INDUSTRY IN INDIA (1961-1979)

(Source: Bist, 1981b)
ceramic body and glazes. Quartz is widely used as raw material because it is inexpensive, chemically stable, relatively fusible and has ability to form glasses in the body. Some metal oxides like zinc oxide, zirconium oxide, alumina, lead oxide and borax are widely used in the glaze preparation to maintain and improve the quality of the glaze. Some other metal salts, like lead chromate, chromium oxide, cadmium oxide, cupric oxide, manganese oxide, ferrous oxide, potassium dichromate, titanium oxide, nickel oxide, etc. are used as the colouring agents.

In the manufacture of ceramic wares, different steps involved in the entire process are shown in Fig. 2. All non-plastic materials, like clay, stone, quartz, feldspar, etc., reduced to a finer size by crushing or grinding in grinding cylinder with water, and resulting semiliquid slipage are passed through selected sieve screen to remove the coarse particles. To obtain a plastic body called "filter cakes", surplus water is removed from the semiliquid slipage by filter press process. For shaping the wares, different processes, like slip casting, throwing, pressing and jollying, jiggering, are adopted, depending upon the types of the product to be manufactured. After shaping, the wares may be dried and finished by the processes like fettling, towing, sponging, etc. After that, glaze may be applied to the dried wares directly or after biscuit firing, by dipping the wares in the glaze liquid or by spraying the glaze on the body. Decoration may be applied either under the glaze or over the glaze and may be by hand paintings or machine printing. Then the wares are fired generally in down drot type kiln or in tunnel kiln. In some cases, decorative stickers or transfers may be
FIG. 2
DIFFERENT STEPS INVOLVED IN THE MANUFACTURING PROCESS OF CERAMIC WARES.
(Source: Hamilton, 1974)
applied over the glaze fire wares which require additional firing.

The crushing and milling of clay, quartz, feldspar, etc. produce air-borne dust in ceramic factories. Moreover, subsequent drying of plastic slip and body on the benches, equipments, floor and workers' clothes are the serious sources of the atmospheric dust. During the dry finishing of dry wares by jollying-jiggering process, lot of dust spreads in the environment. During the glaze spraying process, significant amount of glaze dust spreads in the working environment causing the silica as well as lead hazards among the glaziers. In kiln department of small scale factories, firing process, loading and unloading of kiln are carried out manually where the chances of exposure to very high ambient temperature are there.

In small scale ceramic factories, workers are exposed to multiple stress factors like dust, heat, toxic metals, noise, etc. during the work shift. Moreover, the multiple factors like poor hygienic practice, unawareness towards the occupational hazards and carelessness among the workers are responsible to impair their health. Hence, in the present study, an attempt is made to assess the work environment of small scale ceramic factories in relation to occupational exposure risk.