

# Towards Cleaner Technologies



A process story in the Firozabad  
glass industry cluster

# FOREWORD

The history of glass-making in India goes back thousands of years when beads, bangles and other small glass items were made in kingdoms in North and South India and traded with other ancient civilizations such as Persia, Greece, and Rome. Indeed, the origin of glass bangles is perhaps as old as the Indus Valley Civilization; the famous bronze figurine of a dancing girl unearthed by archaeologists at Mohenjo-Daro (c. 2500 BCE) has her left arm and wrist completely encased in bangles. Interestingly, the very word ‘bangle’ is derived from the Hindi word *bangri*, meaning ‘glass bracelet’! Over the ages, the bangle has come to be closely associated with the institution of marriage or *suhag* throughout India. Today, the nation buys an estimated 50 million bangles each day, and all these bangles are made by units in the small-scale glass industry cluster at Firozabad (or ‘suhag nagri’ as it is popularly called), located about 40 km from Agra, the city of the Taj Mahal.

Traditionally, Firozabad units use open pot furnaces to produce glass for processing into bangles. Besides the open pot furnace units, Firozabad also has hundreds of muffle furnaces or *pakai bhattis* to anneal the finished bangles. Till the mid-1990s these furnaces operated on coal and/or wood. TERI undertook energy audit studies at that time, which revealed that the energy consumed by the furnaces was very high and that there was ample scope to reduce their existing levels of energy consumption. The Firozabad glass-making industry came into the limelight in December 1996, when the Supreme Court of India ordered 292 coal-based factories in the area known as the Taj Trapezium Zone, including the Firozabad pot furnace units, to switch from coal to cleaner alternative fuels such as natural gas, or else to relocate or shut down. Although the Court directed the government to supply natural gas as an alternative fuel to the affected industries, the pot

furnace units – which constitute the apex of the multi-level bangle-making industry – had neither the technology nor the know-how to operate their pot furnaces on gas at that time. Hence, they faced the prospect of closure; and this threatened the future of tens of thousands of families in Firozabad who depended on the bangle-making industry for their livelihood.

It was against this backdrop that TERI (The Energy and Resources Institute) with the support of SDC (Swiss Agency for Development and Cooperation), set out to develop clean, energy-efficient technologies based on natural gas for pot furnaces and *pakai bhattis* in Firozabad. By carrying out intensive action research in a participatory manner, and by pooling the competencies of international experts, TERI successfully designed, developed, and demonstrated two such technologies: the gas-fired recuperative pot furnace, and the gas-fired *pakai bhatti*. The TERI-designed pot furnace reduced energy consumption by nearly 30% compared to the other ‘retrofitted’ gas-fired pot furnaces that came up in the cluster. The gas-fired *pakai bhatti* design helped in reducing particulate emissions and thereby greatly improved the environment in the workplace.

Close involvement with the cluster over the years has made TERI aware of the health hazards faced by workers in the household-level units that processed bangles and other decorative items. TERI therefore also partnered with an NGO (non-governmental organization) to initiate a few pilot social action initiatives in select areas of Firozabad, aimed at bringing about improvements in the lives of household unit workers.

SDC has contributed greatly to the success of the intervention: by allowing TERI to remain engaged with the Firozabad cluster for an extended period of time, as well as by giving TERI the room to alter its strategies and activities on an ongoing basis to meet the challenges of the changing external environment. Today, over half of the 80-odd open pot furnace units in Firozabad have adopted the recuperative furnace design developed by TERI, and most of the remaining units are expected to follow suit in the next few years. This is a very significant achievement, considering that there were just two TERI-designed pot furnaces operating three years ago. TERI’s dissemination strategy in Firozabad was based on three pillars: (1) optimizing furnace design parameters to suit the needs and demands of the local entrepreneurs; (2) ensuring the success of the first few replications through close monitoring, both during construction and operation; and (3) capacity building of operators and entrepreneurs.

However, the story is not as encouraging with regard to the gas-fired *pakai bhatti*, despite its proven benefits. The number of gas-fired *pakai bhattis*,

which once reached a figure of 100 units, has now dropped to just around ten. The primary reason is that *pakai bhatti* units have been unable to obtain gas connections at their existing locations. At the same time, gas prices have sharply escalated in recent years even as coal continues to be available in Firozabad at comparatively cheap prices.

TERI's experience in Firozabad, as indeed in other SSI (small-scale industrial) clusters over the past decade, brings to focus the fact that in order to achieve significant gains in terms of increased energy efficiency and reduced carbon dioxide emissions in this highly dispersed sector, it is extremely important to develop cluster-specific technology intervention programmes with clearly defined objectives. The Firozabad experience also highlights the fact that small-capacity users of energy, such as *pakai bhatti* operators and household-level processing units, find it very hard if not impossible to access cleaner fuels at affordable prices.

It is important to start looking at the SSI (small-scale industry) clusters from a social perspective, as they provide employment opportunities for millions to workers, and also act as nerve centres for the overall growth of the rural and peri-urban areas in the country. Greater attention must be paid to the technological and R&D (research and development) needs of SSI clusters, so as to ensure that higher energy and environmental standards become an integral part of the nation's overall economic growth process. TERI will provide impetus to the sustainable development of this sector through its ongoing initiative titled CoSMiLE (Competence Network for Small and Micro Learning Enterprises), by continuing to work with various stakeholders both at the national and international levels. TERI will build upon the lessons and knowledge gathered during the intervention in Firozabad, for the benefit of the SSI sector as a whole. The focus will be on knowledge-sharing through technology interventions and innovative practices, programmes, and projects.

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