

Features

**THE AGATE INDUSTRY AND SILICOSIS
IN KHAMBHAT, INDIA**

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ABSTRACT

Agate stones have been shaped and polished into beads and other decorative items for thousands of years in Khambhat, India. Agate is a silicate quartz that produces a fine dust when shaped and polished. The people who shape and polish the stones in workshops in their homes are being sickened with silicosis, as are their families and neighbors. These home-based workshops are unregulated and the workers and their families have no access to occupational health services or workers' compensation when they become ill. Occupational health activists have tried to find an effective strategy to confront these working conditions and protect the health and livelihood of the agate workers. They have had limited success, and huge challenges remain.

Khambhat is an ancient town in Gujarat state in western India. Ornaments and other decorative items have long been manufactured from agate and other stones in Khambhat and the surrounding villages. The industry is controlled by the agate traders, but the work of shaping the agate stones is done by workers who use their homes and the outdoor space in their neighborhood as workshops.

The rough agate stones and other gems such as onyx, amethyst, lapis, and quartz are turned into beads and other shapes for decorative items. These items include necklaces, pendants, earrings, bracelets, pencils, lamp shades, bowls, spheres, religious symbols, small statues of mythical, religious, and animal

figures, and many more. It is believed that the agate industry has been going on in the region for 2,500 years.

THE AGATE MANUFACTURING PROCESS

The manufacturing process includes steps such as sun drying, breaking larger stones into small pieces, slicing, rounding in a ball mill, shaping on grinding wheels, polishing for luster, drilling holes, and assembling the final product. All these steps are carried out by different sets of people, known in Gujarati as, for example, *fodia* (chipper) or *ghasiya* (polisher) [1].

Primary size reduction is done by *chippers*. A pointed iron rod is embedded in the ground, sticking up at an angle. A stone is held against the rod by hand and struck with a hammer made of animal horn, in order to chip the stone into smaller pieces. The chipper must break the pieces while keeping in mind the final product to be created from it. Hence this is a very skilled work.

Rounding and further size reduction is sometimes done in a drum made of wooden planks—a sort of ball mill, powered by an electric motor. This is a very dusty and noisy process. Many *middlemen*—men of the working class who employ other workers, but may also work alongside them—build walls around the mill to prevent silica dust from blowing everywhere. The walls also help contain the noise of the mill.

Polishing or grinding is done by *polishers*, who are exposed to a lot of silica dust. Polishing is done in many ways, depending on the product. A horizontal wooden bench with a vertical moving emery wheel powered by an electric motor is most commonly used (Figure 1). Polishing by hand is usually done dry, though in the last few years some have begun to use wet methods. For shaping spherical beads, polishers use a rectangular wooden plank 6- to 8-inches wide and 2½- to 3-feet long. Several rounded grooves are etched into one end of the plank to hold the stones, and a matching set of grooves is chipped into the emery wheel. Rough agate stones are arranged on the etchings and pressed against the grooved emery wheel. A little oil is used to lubricate the stones as they revolve during the shaping process.

Giving luster to the stones is done by various methods. The most popular is to tumble the stones in metal drums with water, emery dust, and aluminum oxide.

When needed, stone slicing is done by a specialized machine. Until a few years ago, only one employer did this work, and he kept the method secret. Now, there are smaller machines available, and a few more people are doing this work. Stone slicing is sometimes done in an enclosed machine using kerosene as a coolant. In other places it is done in a smaller machine, using a dry process that produces a lot of noise and dust.

Drilling used to be done manually (as shown in the picture), creating ergonomic problems. Now electric machines are used for drilling. Final assembly is done manually.



Figure 1. Agate worker shapes a stone on a horizontal grinding wheel.

INDUSTRY STRUCTURE: SELF-EMPLOYED ARTISANS OR EMPLOYEES?

This is no longer an industry of home-based artisans who sell their products at the market. The industry is mainly controlled by the traders who own show-rooms in the city of Khambhat. Most of these traders export their products. Once they found a big market in the Middle East and African countries. Now the United States, Hong Kong, Thailand, and some European Union countries receive most of the agate exports.

The traders buy several types of stones (e.g., agate, onyx, amethyst, lapis, and quartz) from around the country. Then each trader gives out the various manufacturing tasks to different people to turn the stones into finished products. Some traders have the preliminary jobs, such as sun drying and breaking down the big stones to smaller pieces, done on their premises. For all traders, the rest of the manufacturing process is carried out by workers or middlemen at their own premises. Most middlemen employ fewer than five workers, and also put in physical labor themselves; they come from the same socio-economic class as the workers. There are a few middlemen who employ 5 to 10 workers. However, large numbers of workers work at their homes with their families.

Payment to the workers in all stages of the manufacturing process is by the piece. Each stakeholder in the agate business has several business partners, and hence a legally defined employer-employee relationship is usually absent between the trader, middleman, and workers. Legally speaking, most of the agate workers who work from their homes are considered to be self-employed craftsmen and craftswomen, and the workers view themselves in this way. In reality, however, the trader is the person investing in raw material, deciding what objects are to be made, deciding who will make them, and ultimately collecting the final products made from the raw materials he supplied. The trader then sells the items. The traders view themselves simply as traders. We contend traders are more than this: they are the employers of the agate workers, and of the middlemen. Like the traders, however, the law does not view these relationships as employer-employee relationships. Estimates vary, but there may be anywhere from 15,000 to 50,000 workers in the agate industry in India.

Most agate workers are paid a low piece-rate for each gem they work, and these rates are fixed by the traders. The workers are not organized to negotiate the rates. Efforts of workers to organize are frustrated by the traders, with many forbidding workers to attend meetings or events of any kind. As a result, what income the worker earns is used to buy grinding wheels and electricity, and to pay any other workers he or she has hired. That leaves little for anything else, beyond a small income to live on and support a family. In addition, some workers begin this work when they are 14 or 15 years old, sometimes even younger.

POVERTY AND FORCED LABOR

While India is growing increasingly wealthy, Khambhat's agate workers have few decent job options. Agate work may be dangerous, but it provides a regular income that can support a family. This work pays somewhat better than most of the other available jobs in the area. Despite having regular work, agate workers are among the working poor of India, with few assets to fall back on if the work ends or if a family emergency arises. These workers have no minimum wage set in law, no social security in case of illness or disability, and no occupational health services; further, no one will sell them life insurance due to the known risk of premature death from their work.

Due to their poverty, agate workers commonly find they need to borrow money for medical treatment, marriage, funerals, or other major life events. They usually get this money by taking an advance from a trader or middleman. Interest is not charged; instead the piece rate paid for each piece of agate worked is 30 to 50 percent lower than the rate given other agate workers. These loans are not documented, and the worker relies on the middleman or trader to decide when the loan is finally paid. Though the worker continues working, he or she is never able to pay off the loan. Workers may find they need to take another loan, deepening the debt. The worker is not free either to change to another line of

work or to work for a different trader/middleman until the debt is fully repaid. If a worker tries to change jobs, the trader/middleman will physically coerce and bring back the worker to continue agate work for him. If a worker dies, some traders/middlemen ask other family members to work to pay off the debt. The whole situation compels the family to continue to work with the same trader/middleman. Many employers like the workers to take loans, because it guarantees their workforce for years in the future. A contributing factor is that some workers have a habit of drinking alcohol, a habit that some employers encourage by supplying workers with alcohol.

These are clearly the signs of bonded labor, a type of forced labor. The Bonded Labor Abolition Act of 1976 prohibits bonded labor in India, but it has not prevented this longstanding practice in the agate industry. Workers are not allowed to attend any meetings or activities organized by voluntary organizations. Because of these circumstances, these workers are not organized into unions or any other voluntary association to advocate on their own behalf.

SILICOSIS IS A SERIOUS PROBLEM

At one time the agate industry was pure handicraft and art. But after the introduction of electricity, in about 1940, the pace of work increased. Grinding agate stones on a grinding wheel driven by electricity at a speed of 2,000–3,000 RPM generates a large amount of dust. The dust contains fine particles, about 2–5 microns in size, which are inhaled deeply into the lungs, reaching the alveoli. Agate is a silicate quartz, and agate dust contains more than 90 percent free silica. Thus when an agate worker inhales agate dust, silica dust settles in the lungs, causing silicosis. It takes only 5 to 10 years of exposure to get silicosis from doing agate work. It is only recently that some people in Khambhat have learned the difference between silicosis and tuberculosis (TB), and understand that TB is curable while silicosis is incurable, progressive, and fatal. Large numbers of agate workers, both men and women, have died of silicosis. A number of families have been completely wiped out in this way.

Once a worker gets silicosis, his condition is dire. In many cases there is no one to look after him, no workers' compensation, no alternative employment. He may be in debt, in which case he is compelled to continue working until he dies. If he stopped working, he and his family would not have money to put food on the table, pay for transport, visit a doctor, or pay rent. The widows have their own problems of earning a living after a husband's death, losing a significant income of the family, and having to become the breadwinner alone. The elderly family members of an agate worker lose their support when that worker dies of silicosis. A large number of women work as grinders (Figure 2), so the death rate among women is also high. Many children have been left orphans due to silicosis. When both parents are lost, and if no other family can take over caregiving, the older children are left to become the breadwinners for their siblings.



Figure 2. A former agate grinder suffering from silicosis, and her children.

There is a social stigma against agate workers, even before they become ill. Younger agate workers of marrying age do not easily find a bride or groom, because the bride's or groom's family will not want their child to marry someone who will face early illness and death, and the resulting poverty. Even the children of agate workers can find it hard to marry due to the stigma of a possible deadly illness in the family. Marriages can break up when one of the couple gets silicosis. These families, their community, and society at large are paying a high price for this situation. This is one of the most tragic stories of "development" in Gujarat.

Though silicosis is a compensable disease under India's Workmen's Compensation Act, there has not been a single case of silicosis claimed by the agate workers. How can this be when, as we show below, so many agate workers have been found to have silicosis?

Doctors, both government and private, do not diagnose silicosis when they should. Doctors do not seem to know of or appreciate the risk posed to agate workers by their work, or the need for proper diagnosis of silicosis, much less the need to trace back from each silicosis case to find out how a young adult can have silicosis. Workers go to the doctor for relief of symptoms, and the doctor, by prescribing medicine, gives some relief. Private doctors send the workers for X-rays, since that earns them hefty commissions from the radiologist, and also to the pathological lab for sputum testing for TB. However, silicosis can be diagnosed based on an occupational history and an x-ray reading. Workers have access to doctors and doctors have access to equipment, but diagnosis of silicosis is still rare, despite an epidemic of silicosis among agate workers and many others in the dusty industries of the country (stone crushing, mining, etc.).

Workers, for their part, do not insist on being diagnosed, because for them a diagnosis of silicosis has no practical use. They are labeled as ill, but from this label they will receive no workers' compensation, no free medical care, and no disability or death benefits to ease the burden on themselves and their family.

Workers do not file workers' compensation claims for many reasons. The many agate workers who are classified as self-employed have no legal right to compensation from anyone. Those few workers who are covered by workers' compensation often lack knowledge of their right to compensation. Workers often lack documents to prove that they were employed, if they were employed by a middleman. Another factor is that an ill worker may lack proper medical documents to prove that he or she is suffering from silicosis, due to the doctor's failure to diagnose it. An ill worker must also consider the high cost of filing a legal claim. The Indian legal system is very time consuming—a properly handled compensation case commonly takes three to five years for a decision and an order to pay. Many small, uninsured employers will ignore the order, making the worker go to court to demand payment, which takes more time and is very frustrating to the worker. In larger factories, where the employer has a workers' compensation insurance policy, payment is easier. Workers understandably do not have any trust that the legal system can deliver them justice once they are ill.

Fear of offending those in a higher social class, and fear of physical coercion, are also problems that limit workers' willingness to pursue diagnosis and compensation. The bonded labor situation in this industry is one illustration of this. Indian society is not completely free of a feudal system of power.

Silicosis is Well Documented in Agate Workers

If you visit an agate-grinding neighborhood of Khambhat, you will notice right away the fine light gray powder that covers the area. You notice it first where it covers the tumbling or grinding equipment, the nearby ground, and the workers' hands, and perhaps their faces and clothes. But if you look a bit more closely, you notice this fine dust is everywhere, on every surface, thick in some areas and thinner in other areas. After decades of electrified agate grinding work, the neighborhood is covered in powdered agate—powdered silica. This dust is just the visible sign of the danger to the people who breathe it.

In 1961 during the Census, special reports were prepared on selected crafts carried out in Gujarat. One of the selected crafts was agate grinding. The report notes,

The worker keeps one small earthen vessel filled with water by his side and the articles are dipped in water before they are put on the emery wheel to avoid the powder going into the breath of the workers. If water is not used, the wheel moves more rapidly giving better cut and greater output. But it releases tiny particles of dust which are detrimental to the health of the workers. It is believed that while breathing, the stone powder goes inside the lungs and causes TB. As the ghasiyas (polishers) are given wages on piece rate basis, they do not dip the stone in water and thereby get greater output of seven or eight pieces per minute. But by doing so they render themselves liable to this fatal disease which is reported to claim three to five deaths per year. [2]

In the 1980s the Industrial Toxicology Research Centre (ITRC) in Lucknow, India, carried out a study of the respiratory morbidity of 342 agate chippers, grinders, and drillers [3]. Of the workers, 48 percent had less than five years' exposure, and 34 percent had six to 10 years' exposure. An incredible 63 percent of all the agate workers were found to have lung disease (versus 35% among controls). Among all agate workers studied, the prevalence of pneumoconiosis was 18 percent (with no cases found among controls); of pulmonary TB, 16 percent (12% among controls); of chronic bronchitis, 3 percent (7% among controls), and of bronchial asthma, 7 percent (less than 1% among controls). The prevalence of total lung disease by age was 47 percent among workers aged 20 or younger, 64 percent for workers 21 to 30 years old, and 83 percent for workers 31 and older (more than four of every five workers in this age group). The prevalence of pneumoconiosis was the highest among workers 31 and older at 24 percent; for those aged 21 to 30 years, it was 20 percent; and

for workers 20 or younger it was 12 percent. The prevalence of TB increased with increasing age. Pneumoconiosis was documented in workers exposed to dust for as little as two years. The prevalence of pneumoconiosis showed a dose-response relationship in both male and female agate workers, who experience similar rates of pneumoconiosis. Findings of lung disease among children were stunning: 51 percent of children were found to suffer from some kind of lung disease, and 14 percent had *both* pneumoconiosis and TB. Exposure to dust for less than 2 years was shown to cause pneumoconiosis, and the youngest child with pneumoconiosis was 11 years old. Levels of respirable dust were 186 mg/m³, or about 1,300 times the legal limit, based on measurements showing that respirable dust in the work areas was 70 percent silica.

In 1987 an epidemiologic study of 470 agate workers was carried out by the National Institute of Occupational Health (NIOH) [4]. The overall silicosis prevalence was 29 percent, and the prevalence among grinders was 38 percent. Progressive massive fibrosis (PMF) was observed among 8 percent of the workers, and the prevalence of TB was 30 percent. This is a staggering level of illness among a group of workers in any industry.

In 1993 the NIOH did a follow-up study of 150 randomly selected subjects from the 1987 study [5]. Among the 91 subjects who were available in 1993 for follow-up, overall silicosis prevalence was 41 percent, and the prevalence among grinders was 64 percent and non-grinders at 23 percent. The 1987 study estimated that there were 15,000 agate workers nationally, which means thousands of agate workers suffer from silicosis across the industry.

NIOH carried out a third study during 1999–2004 [6]. It was an environmental and medical survey to develop biomarkers for silicosis and to redesign a dust control system to make it more effective and acceptable. The survey showed a prevalence of silicosis among all agate workers of 29 to 36 percent, a prevalence of TB of 27 to 50 percent, and a prevalence of silico-tuberculosis—that is, of both conditions together—of 15 to 26 percent. The studies establish clearly that prevalence of silicosis increased with duration of grinding. The prevalence of silicosis among workers with fewer than 4 years of grinding experience was already at 9 percent, while the prevalence among workers with more than 17 years as grinders was 59 percent.

A non-occupational group of neighbors, household members, and other non-workers showed high prevalence of silicosis (6–13%), TB (20–23%), silico-tuberculosis (2–8%). Children and women working near the agate units were suffering from silicosis and silico-tuberculosis.

This NIOH study also analyzed the quartz content in dust samples. The average quartz content in the total dust was 34 percent and in respirable dust was 30 percent. Quartz content in dust collected from the bag filter was 39 percent. Dust levels in horizontal and vertical shaft machines were measured and found to be much higher than the prescribed legal limit. Similar to the U.S. Permissible Exposure Limit (PEL), the Factories Act of 1948 states that the permissible levels

for free silica (quartz) in respirable air be calculated by following the formula: Permissible respirable dust = $10 / (\text{percent respirable quartz} + 2)$ mg/m³ of air. By this formula, the permissible respirable dust levels for dust of 30 percent quartz would be 0.31 mg/m³ of air. Respirable dust levels were in the range of 3 to 7 mg/m³ in vertical shaft machines (from 10 times to more than 20 times the legal limit). Respirable dust levels were in the range of 2 to 3 mg/m³ in horizontal shaft machines (7 to 10 times the legal limit).

More recently, a 2007 study of 123 suspect cases of silicosis among agate workers reporting to a clinic in Khambhat found that 70% of them did indeed have silicosis confirmed by chest X-ray. Of the cases examined, workers with more than 10 years exposure to silica had an odds ratio of 4.8 compared to those with less than 10 years exposure. Analysis showed that for every extra year of exposure the odds of getting silicosis increased by about 12% [7].

Silica in the Community

The 1999–2002 NIOH study reported 60 grinding units and 14 drum machines in a single community. In this community, environmental dust was studied and the dust concentration was found to be in the range of 205–325 mg/m³. The quartz content of the dust was found to be in the range of 3–9 mg/m³ (or about 2%). The average respirable dust concentration in the vicinity of the grinding units was around 15 mg/m³. There was a high prevalence of silicosis (6–13%) and silico-tuberculosis (2–8%) in the non-occupational group that was examined.

The agate manufacturing area is not separate from the community. Most agate workers work in or near their homes. Gujarat has a warm and sometimes humid climate, and the houses have no glass in the windows. When the weather is warm, most agate workers work in the shade of a porch or awning outside of the house. The worker is perhaps most exposed to the deadly silica dust, but the other occupants of the house, including children, are also exposed. It is not unusual to see a mother polishing agate with a child in her lap. The ITRC study showed silicosis among small children. The agate dust has spread all over the community freely, and the people in the neighborhood are exposed to the dust daily. This is an environmental problem where large numbers of people are at risk. Aside from the risk of silicosis, breathing in silica dust increases the risk of lung cancer, autoimmune disorders, and kidney disease, as well as increasing the risk of TB.

THE STATE OF HEALTH AND SAFETY LAWS

The existing law for protecting the health and safety of workers in the manufacturing sector is called the Factories Act. The Act is a Central Act, meaning that amendments can be done only by the central government, while it is the responsibility of the state government to implement the Act. Section 85 of the Act

empowers the state government to declare any manufacturing operation as *hazardous* and make specific rules to regulate it. Work that exposes workers to dust that is more than 5 percent silica is deemed hazardous and is regulated. The rules regulating workplaces with silica require them to control dust to an acceptable level using effective exhaust systems, provide workers with pre-employment and periodic medical examinations by a certifying doctor, maintain the exhaust systems, and so forth.

Originally, the Factories Act applied only to workplaces carrying out manufacturing activities and employing either 10 or more workers (in workplaces using electricity) or 20 or more workers (in workplaces not using electricity). In 1974, the government of Gujarat used its rulemaking powers to reduce the size of a covered factory unit to 5 workers if the workplace employs a hazardous process. Rather than trying to reshape the view that the agate workers are self-employed workers, the government continued with the prevailing view that traders have no employer-employee relationship with the agate workers. The government gave no rationale as to how this legal change would protect workers, nor did it declare why it thought to cover the smaller units. No study was ever undertaken of smaller units on the prevalence of various occupational diseases or the condition of the work environments. Nor did the government promise how its action would lower the incidence of occupational diseases. The government also did not declare how it will ensure implementation of the new requirement in such small factory units.

Continuing with this flawed logic, in November 2008 the government of Gujarat again lowered the size of a covered factory unit, to one worker in the case of workplaces using silica and asbestos. Again, the government did this without doing any groundwork to look at feasibility, nor making any plans to help very small and one-person workplaces comply with the Factories Act requirements.

The New Rules Will Not Help

We are afraid the decision to cover all the agate “factory units” employing one worker will not reduce the hazardous working conditions for the agate workers. It also will not help agate workers gain access to occupational medical care and workers’ compensation for silicosis. There are many reasons to fear that this rule change is not getting to the root of the problem.

The principal problem is that before the recently amended Factory Act, an agate worker working in the open space in the front of his home was legally viewed as a worker or craftsman. After the amendment, this lone worker is now an “employer” responsible for implementing the Factory Act rules in his “factory unit”—meaning the open-air work area in or beside his home. By the stroke of a pen, his or her status is changed on paper, but in reality, this is still a poor agate worker, with little money or knowledge to allow him or her to

implement the rules: to see the doctor for the required medical screening, to put in place and maintain dust control systems, or to pay for social insurance programs. This worker is often a bonded laborer, making it impossible for him or her to leave the trade and close the “factory” doors.

Despite the wording of the Factory Act, the real employer of the thousands of agate workers is the trader. The trader remains free from any legal responsibility for the health and safety of the agate workers, and free from providing any health care, social security, or workers’ compensation for workers who become ill. It is the economic relationship between the traders and the workers that defines the reality, and this remains intact. The legal changes do not guarantee that the nature of the industry will change from unorganized to organized, or that workers can advocate for themselves and their needs. Unless that is done, proper agate workshops will not be set up with safer technology, clinics will continue to be unable to diagnose silicosis, and ill workers will continue to live and die without adequate medical care nor workers’ compensation.

Another major barrier to implementing the law is the lack of inspectors to enforce it. The Director of Industrial Safety and Health (DISH) within the Department of Labour and Employment of the state of Gujarat is responsible for enforcement. We have been told that more than 40 percent of inspector positions in Gujarat are vacant, and since 1990 no new inspectors have been hired. The problem was made worse in 2009, when the central government decided to implement official recommendations to increase the salaries of government workers. This has brought both state and central government under great financial pressure, so they have stopped even temporary recruitment of inspectors to fill vacancies.

Another factor is lack of information. Agate workers and middlemen probably do not have information about the new amendment, and the government does not invest in informing people about the rules and how to implement them. If agate workers had the information, many of them would still be unable to implement their obligations, which were designed for larger employers, not the self-employed.

Since 1974, only eight agate units, employing a total of 32 workers, have been registered under the Factory Act nationally. In addition, the government claims that not a single worker has died due to silicosis among agate workers of registered companies. However, the government’s own reports (by NIOH and ITRC, described above) have shown the extremely high rates of silicosis among active agate workers, and an estimate of 15,000 or more agate workers nationally. We conclude that the government is doing little to ensure that agate factories are registered, that dust control measures are put in place, or that agate workers get access to diagnosis and compensation for silicosis.

If enforcement of this law does begin, we fear agate work will go underground. Workers will go far away into the fields to work, where inspectors will

not have access. Or they will go inside their huts and continue work behind closed doors, increasing the dust concentration in the air that they and their families breathe. People will continue working either because no inspectors are there to inspect them, or by hiding, or by paying bribes to keep the inspector from finding any problems. On paper it will appear there are no workers in hazardous agate factories, but in reality workers, their families, and their neighbors will continue dying of silicosis.

Effective Dust Controls Have Been Developed

Government organizations like the Industrial Toxicology Research Centre and the National Institute of Occupational Health have studied the problem in great detail and given their recommendations for dust control for agate work. At the request of Vyavsayik Swasthya Suraksha Mandal (VSSM)—a nonprofit organization working on occupational safety and health issues—Gram Technology developed an exhaust system for agate grinding. NIOH also developed exhaust systems, first in 1989 and again in 2002, and did efficacy tests of all these systems. In 1995, Janpath—a network of nongovernmental organizations (NGOs)—donated 10 exhaust systems to agate workers. NIOH also provided 10 complimentary systems to selected employers in Khambhat. Since NIOH developed and refined the safer technology, the role of the People's Training and Research Centre (PTRC) was to propagate and transform the dream of dust control in all agate workplaces into a reality.

INTERVENTIONS BY PEOPLE'S TRAINING AND RESEARCH CENTRE

The PTRC is a nonprofit voluntary organization established in Vadodara, Gujarat, in 1992 to focus on occupational safety and health. In 2002, under a project supported by the Gujarat Ecology Commission, PTRC carried out several programs aimed at bringing about attitudinal change in the local community regarding safer technology, which have been described in more detail elsewhere [8].

Community Visits

In 2002, PTRC visited the agate community in Khambhat and observed and discussed the problems with agate workers, silicosis victims, and traders. PTRC observed that the local exhaust systems donated by Janpath were not in use anywhere. Similarly, the ventilation systems donated by the NIOH were not being used. The reasons given for not using the systems varied. For some, the cost of electricity to run the exhaust system was a problem, while others said it was not convenient to use the system. PTRC concluded the systems were not in use because the employers and workers did not recognize why it was important

to use them. They had not bought into the idea that dust control was needed, and there was no legal requirement that such a system be used.

While talking with community members, PTRC also observed there was not a clear understanding of the difference between TB and silicosis. Most people believed that they suffered from TB and had never heard of silicosis. PTRC decided it was essential to invest in education about silicosis in order to inspire agate workers and the affected community, especially silicosis victims, to demand that the new dust control technology be used. This realization formed the basis for PTRC's future programs with the community.

Literature and Posters Distributed

PTRC printed two handouts in Gujarati giving information about TB and silicosis, and about the exhaust system developed by NIOH. Both these were small, illustrated and easy to understand. PTRC engaged art students at the University of Baroda to design posters, which gave a strong message to install exhaust systems, and these were printed and distributed.

Machine Yatra

Yatra means pilgrimage (see Figure 3). It was a completely new and innovative idea to propagate safer technology for agate grinding in Khambhat by using the familiar ritual of a Yatra. The new local exhaust ventilation system was mounted on a small, open-backed truck, and decorated. The Yatra commenced from the city centre with great fanfare. It went around the streets of Khambhat, through the main gems and jewelry market, and ended in a public meeting attended by the traders, workers, manufacturers, local social and political leaders, and representatives of various voluntary organizations. Speakers discussed the problem of silicosis and ways to prevent it through the use of the exhaust ventilation system. For the next several days, the Yatra moved around Khambhat, visiting 81 agate units and contacting over 200 grinders, 300 other agate workers, and 1,000 members of the community. Response was very positive. For large number of workers, this was the first chance to see and run the ventilation system, and to see literature on it. As a result, 10 agate units expressed their willingness to install such a system.

Health Fair

In 2001, PTRC held a two-day Health Fair in downtown Khambhat. It was estimated that 15,000 to 20,000 people from all walks of life visited the fair. PTRC's Primary Health Centre and the National Institute of Occupational Health took part, and several health organizations had booths at the event. PTRC put up an exhibit called "Our Work, Our Body" and another on silicosis. A model of a local exhaust system for agate workers was on display and was the center of



Figure 3. Machine Yatra (pilgrimage) travels around Khambhat.

attention. Several victims of silicosis visited the fair, and some agate grinders became interested in installing safer technology.

Street Play

PTRC contacted local youth to put on a street theatre and found a group of volunteers from among silicosis victims. Aditi Desai, a well known theatre personality, directed the play. The name of the play, *Jivtar nu Machine (Machine for Life)*, was suggested by one of the team members. Shows were held for several weeks around the community. At one place, a few minutes after the play began, two local employers stopped the play and asked the theatre group to leave. They said the show would affect their business badly and they would not allow it to continue. On another occasion, 1,500 people came to see the show. Some women wept while watching. At the end they said, “This is exactly what has happened to us and our family.” As a result of the play, there is a strong sentiment in the community in favor of using safer technology.

Community Silicosis Conference

At the end of 2003, PTRC organized a conference to provide a common platform to silicosis sufferers, widows, orphaned youth, small and large employers, traders, government officials, concerned citizens, and NGO representatives to share their concerns, problems, efforts, and plans for preventing silicosis. More than 350 people participated. To decorate the meeting venue, PTRC prepared 41 posters, each showing the name and date of death of a local silicosis victim. A new exhaust system developed by PTRC was also exhibited, and Jagdish Patel, Director of the PTRC, spoke about its objectives and gave details of its activities and their results, as well as problems faced. Silicosis victims spoke about their problems, how they came into the agate business, how they got silicosis, and the problems faced by silicosis widows.

Technical Consultation

During 2002 and 2003, PTRC helped several employers install exhaust systems.

Forming a Victims' Association

In September 2006, PTRC helped silicosis victims—patients, widows, orphans, and elderly people—to form a victims' association. The association was expected to take up the cause and implement programs for silicosis prevention, compensation, relief and rehabilitation, care and support, and capacity building. Unfortunately, there is an absence of local leadership from among the victims, so the Association has not taken up significant activities or grown in members.

Films and Television Reports on Silicosis Deaths

Joseph Alkazi, a well-known documentary film maker, made a film called *The Living Stones* for the National Television Network and regional broadcasting. The film was in English and inspired PTRC to visit Khambhat's agate community for the first time in 1990. Since then a number of television channels have done stories about the situation.

A documentary film maker from Delhi sought PTRC's help in collecting information and arranging visits and interviews with different stake holders. The film *A Way to Dusty Death*, produced by the national government's Public Service Broadcasting Trust in 2007, is a result of these efforts [1]. It is an excellent film, in English, which was broadcast on the National Television Network. PTRC uses the film as a tool for advocacy. PTRC met with several eminent personalities, institutions, and organizations to seek their help, guidance, and support for the cause through this documentary. This film was chosen as the best documentary film for the year 2006–07 by the Government of India.

Representation with National Human Rights Commission

In July 2004, Jan Swasthya Abhiyan (the affiliate of People's Health Movement–India) and the National Human Rights Commission (NHRC) jointly organized a public hearing to discover and discuss specific examples of the denial of the “right to health care” in India. PTRC participated in this hearing and persuaded one of the Khambhat silicosis victims to present his case.

Assisting Workers with Compensation Claims

PTRC was established with an objective to help workers get diagnosed and compensated for occupational diseases. In Khambhat this has been a problem for the reasons we have described above: 1) there is no employer-employee relationship, so no compensation can be claimed; 2) in the few cases where there is such relationship, it is difficult to establish in the court due to the lack of documents proving either employment or a diagnosis of silicosis; and 3) few workers are willing to come forward to make a claim. Now after years of efforts, PTRC has some hope. One worker has come forward to file a claim, and there is a document saying he has silicosis. He had left agate work, but now his employer is asking him to return the advances he took—to the tune of 30–35,000 rupees (about \$700). PTRC has recently sent an application to the District Magistrate requesting him to take action under the Bonded Labor Abolition Act. This is the first time that a worker has shown the courage to act. PTRC does not know what problems it will face from this application, since government

officers never like to accept that the bonded laborers exist in India any longer, and the community of agate traders and middlemen may fight back.

Advocacy Outside of India

PTRC realized there was a need to take the silicosis prevention cause outside of India. This effort began in February 1990, when the *Workers Health International Newsletter* (in the United Kingdom) published an article by Jagdish Patel about silicosis in a glass factory in Baroda. In 1992 PTRC visited the United Kingdom to talk about silicosis among agate workers and attended the annual conference of the Hazards Campaign (similar to the COSH movement in the U.S.). Following from that event, a photo-essay on PTRC's work was published in *Hazards* magazine in April 2006.

In 2002 PTRC began connecting to the Asian Network for the Rights of Occupational Accident Victims (ANROAV). Out of this involvement, PTRC participated in protests at the Hong Kong gems and jewelry trade fair in December 2005. An article by PTRC was also published in March 2006 in the *Asian-Pacific Newsletter on Occupational Health and Safety*, published by the Finnish Institute of Occupational Health. Also in 2006, PTRC took part in a joint India-China gem workers' campaign. This included visiting the International Labour Organization (ILO) and World Health Organization (WHO) headquarters in Geneva, Switzerland, and organizing a press conference at Basel, Switzerland, during the largest global gem and jewelry trade fair. During this trip PTRC and others met with organizers of the fair and asked that the fair no longer allow traders who do not respect labor standards to participate. This also resulted in reports published by Labour Action China in 2007 [9, 10].

In the fall of 2007, Jagdish Patel, Director of PTRC, visited the United States and spoke with occupational health and safety activists in several states, and received an award from the American Public Health Association's Occupational Health and Safety Section for the work of PTRC. As a result of this visit, the National Labor Committee visited India to investigate further. In February 2010, the National Labor Committee released a report entitled *Hearts of Darkness* on the agate workers' situation [11]. The National Labor Committee website also presents excellent video of agate workers at work and talking about their conditions [12].

BETTER SOLUTIONS ARE NEEDED

PTRC's primary objective is to bring down incidence of silicosis and upgrade the living standards of agate polishers. PTRC invites readers of *New Solutions* to ponder the situation of the agate workers, and the efforts made so far to improve their conditions, and give your thoughts about better solutions or new strategies that should be considered.

Where should PTRC apply pressure, and how can it do that more successfully? Should PTRC press for changing the nature of the industry altogether or provide safer technology to the individual worker while keeping the nature of the industry intact? What are the challenges in both? Following are examples of strategies that PTRC is considering for the future.

Organize the Agate Workers?

The agate workers are in such a precarious situation that it is very difficult to gather their active support in the change-making process. They are poor, stigmatized, and forbidden by the traders from participating in meeting or associations. It is difficult to get their views known or involve them actively in the whole process of advocating for their interests. How could we involve them more successfully as active advocates when they currently feel so powerless?

Establish the Traders as the Employer?

Should PTRC advocate for a law to put responsibility on the shoulders of traders for the health and safety of the agate workers? The economic relationship between workers and traders needs to be changed. Traders are investing in the raw material, then out-sourcing the manufacturing processes to the agate workers and middlemen—particularly the work of polishing, in which the hazard of silica dust is present. They get away without any responsibility. The so-called manufacturers in the eyes of the law are mainly the thousands of poor self-employed workers. The law should designate the traders as manufacturers/employers instead, except in the few cases where more than 10 workers are employed. This law should create some basic requirements such as dust control, water and sanitation facilities, safety measures for grinding wheels, and so forth. An implementation strategy must be well thought through, and resources for it to be implemented must be provided, or it may meet the same fate as the recent Factories Act amendments.

New Enforcement Powers for NGOs and Workers?

NGOs and workers will have to be involved in implementation of any laws regulating agate work, such as establishing the traders and the employer. The NGOs and workers will need legal powers to successfully take up this role. What kind of powers could we demand? Are there examples of similar powers given to NGOs in other countries?

Adopt the ILO Convention 177 on Home Work?

PTRC could campaign for the government of India to ratify ILO Convention 177 on Home Work [13], and for a program to implement it. This convention seeks to have nations adopt a policy on home work that promotes equal treatment

of home workers and other wage earners. If this were successful, there is some hope for these workers. Has this strategy proved useful in other countries?

Establish a Welfare Board?

PTRC could campaign for the government to establish a Welfare Board that would charge fees to the traders, to be used for the welfare of the agate workers. The Board would provide workers with financial and technical support for upgrading workplace machinery, including dust control and exhaust systems. The Board would give workers access to medical examinations and treatment, compensation, sick pay, pensions, and housing. The Board could also be tasked to look into ways to clean up the silica-contaminated work areas, homes, and neighborhoods to reduce environmental exposure to agate workers, their families, and their neighbors. Has this model been used in other places? Was it effective at improving workers' lives?

Government Intervention for Negotiated Wages?

PTRC could campaign for the Labor Department to take proactive steps to improve the conditions of agate workers. It is estimated that there are 15,000 to 50,000 workers engaged in this trade in various processes. Until now, agate workers have been ignored by government policy. The government has not even set minimum wages for this type of work. The workers do not enjoy any benefits of social security: no life insurance, no workers' compensation, no pension, and no severance pay. The industry has remained highly informal and unorganized. The government could bring agate workers into current social insurance programs. The government could establish acceptable minimum wages. The government could bring worker and industry representatives together to negotiate the piece rates sufficiently high that workers can invest in safer technology (and have an improved livelihood).

End Bondage?

PTRC could campaign for the government to take proactive steps to end bonded labor arrangements and enforce laws against it. The system of traders giving loans to workers needs to end. The practice results in forced labor at a deadly job. What strategies for ending bonded labor have been successful? How could PTRC help to enforce the existing law prohibiting bonded labor?

Create Common Sheds?

PTRC could try to arrange for shared sheds to be established with all basic facilities for polishing the stones, including local exhaust ventilation. Such a shared gem-polishing shed could be managed by Panchayat (elected governing board), an entrepreneur, or a workers' cooperative. Polishers could be charged for

using facilities in order to fund ongoing maintenance. The government or a Welfare Board could pay for establishing the sheds initially.

There are options, such as whether to keep the trade relations and structure of production process intact, or whether to change them. If the structure is to be kept intact, workers will bring work from traders as they have been doing at the rates they are getting. The only change will be that they will not be working at their homes but will operate from the common facility and pay fees to the facility. If the structure is changed, a trader could pay the facility for space for his employees. The facility's service provider would be responsible for providing the electricity and machines, including an effective exhaust system. The options for technology are also open: whether to keep the same technology, with the addition of an exhaust system, or to go for more modern, wet process equipment, with exhaust systems built in, improved seating position, and improved safety features. Has a common shed system been used elsewhere? How successful was it?

Improved Technology?

In the past 20 years, both NIOH and Gram Technology developed exhaust systems for agate work. Both came out with good designs that reduced the dust considerably, but both systems used high-horsepower motors. These motors are more costly to install, operate, and maintain than the lower-powered motors typically used in the industry. Since workers do not have negotiating capacity over their piece rate, they cannot get increased pay to cover this added cost. For this reason, workers did not accept these technology-driven solutions. NIOH had not determined how to make it possible for the new technology to be adopted. They somehow felt that it was the agate worker's choice, not a choice constrained by the structure of the industry, which must first be addressed.

Another solution is to use a wet process. The traditional grinding wheel is replaced by a wheel coated with hard metal, and water is dripped onto the wheel from above. Here, too, workers are afraid of lower earnings at the end of the day. It is slower to use a wet process and requires more force be applied to hold the stones, requiring more effort from the worker. Despite the slower pace, some workers have adopted this method.

A Ban on Agate Work?

A ban is one more option, if we can ensure its implementation. This idea needs careful discussions with various stakeholders. The logic is simple: the agate business needs to be banned immediately since it is of no benefit to anyone but the traders. For workers it brings death and misery. The families and society have to bear the burden of sick workers, disability, death, orphans, divorce, and so on. The disability and death of people of working age is a major loss to the economy, and to the individual families and communities who

bear the direct loss of a breadwinner. Since neither industry nor the government has been able to prevent these silicosis deaths in the last five decades (or longer), the business should be banned. Beyond the silicosis deaths, the workers are exploited to the core. They do not get a minimum wage or social insurance. Their children have to start work at an early age. They are given advances by the employers and then are little more than slaves. Even children are not spared. In a small village, we find large numbers of young widows who lead a poor life. The constitutional right to life has not been implemented. The silicosis problem brings bad publicity to Gujarat and India. A just transition is needed to implement any ban. This could include providing the agate workers and their community with compensation for the damage to their health, training for the new jobs, loans for establishing new businesses to employ the agate workers, support for marketing products from the new businesses, and a program to clean up silica-contaminated homes, workshops, and neighborhoods.

PTRC invites readers of *New Solutions* to send in their suggestions and experience with the ideas outlined above. You can contact PTRC at:

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NOTES

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QA: Refs. 5 and 6 are the same-please delete one and renumber here and in text

QA: which is correct spelling? Ref. 4, or 5?

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