India: Vedanta's Oxygen Output in Thoothukudi Is Less CSR, More Disaster Capitalism

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Chennai: If Vedanta were to deliver on its promised 1,050-tonne per day (tpd) of medical oxygen from its sealed Sterlite Copper smelter complex in Thoothukudi, Tamil Nadu's entire projected need of 650 tpd would be taken care of, with some to spare for Kerala and Puducherry as well.

However, experts *The Wire Science* spoke to have said repurposing Sterlite Copper's 1050 tpd wholly for medical purposes will require months, if not more than a year. Until then, the plants inside the copper complex will at best be able to gradually ramp up production to 60-100 tpd of liquid oxygen and whatever little extra it can supply as gaseous oxygen bottled in cylinders.

Vedanta's oxygen, the experts said, will be prohibitively expensive, wasteful and logistically unwieldy. It is not just oxygen that is scarce, but also resources. Why produce expensive oxygen when the same money can be used to set up longer-lasting infrastructure for less expensive and readily usable oxygen in remote places that are at the tail-end of the oxygen pipeline?

Until the morning of May 25, the company had supplied only 21 tonnes per day of oxygen, totalling 150 tonnes over a week of production – against the promised 1050 tpd. For every tonne of liquid oxygen (LOX) produced, Vedanta produces and throws away 10 tonnes of gaseous oxygen. In these seven days, it has emptied nearly 1,500 tonnes of gaseous oxygen (GOX) into the atmosphere.

The oxygen plant that Vedanta is currently operating is part of a larger copper smelter complex, most of which was built illegally without any license. As a captive plant, the entire oxygen production from the plant is intended to be fed continuously in gaseous form to the smelter's furnace.

"It is usual for an oxygen plant to produce 5-10% of the capacity as LOX, which is kept as reserve in case of plant shutdown, when it is vapourised and supplied to keep the production on," Kanchan Choudhury, a professor of cryogenic engineering at IIT Kharagpur, said. "The percentage of LOX is something that is decided at the design stage."

Mostly fixed yield

Because the fraction of LOX that can be drawn is hardwired in the design, tweaking the existing system can yield only minor increases in LOX yield. To significantly change the proportion of liquid-gaseous oxygen from the existing 10:90 ratio, the plant would have to be redesigned – including by installing additional equipment like compressors and turbines. This would take time and money, and entail the erection of new machinery and equipment.

Vedanta's ability to dispatch oxygen across the nation is limited by its ability to produce LOX, which

is easily transported in bulk containers. GOX can be used for medical purposes too but can't be transported in bulk. Over short distances, it can be piped from the point of production to the point of use. Oxygen gas can also be bottled in cylinders – typically of D-type 7 cubic metre (m3) capacity – for use within a district. However, taking this route requires imported oxygen-compatible high pressure compressors capable of increasing the pressure to 150 bar.

It is preferable to bulk-produce medical oxygen in liquid form and transport it in cryogenic tankers to filling stations or on-site cryogenic storage tanks. Filling stations store the oxygen in liquid form, pump it and vapourise it to fill cylinders that can then be taken to the points of use. A tonne of gaseous oxygen can be used to fill about 100 D-type cylinders (of the 7 m3 capacity).

On May 23, Sterlite produced 29.06 tonnes of liquid oxygen and 299 tonnes of GOX. The entire GOX was vented into the atmosphere. Bottling all this oxygen may not be an option either: 299 tpd of gas would require nearly 30,000 cylinders a day. This is about twice the daily demand for cylinders in Chennai, according to ballpark figures provided by a source who is part of a voluntary initiative helping to streamline oxygen logistics. Filling 900 tpd of gas in cylinders, while technically feasible, will involve a throughput of 90,000 cylinders a day. This would be logistical horror.

Two experts, T. Swaminathan, a retired chemical engineering professor from IIT Madras, and Choudhury, whose opinions were sought about the ongoing oxygen production at Sterlite Copper said the process was financially unviable. "I can't understand why Vedanta would want to engage in such a wasteful endeavour," Swaminathan said.

Vedanta has deep pockets but it has seldom dipped into them, at least in the past, to even do what is legally required, leave alone for selfless acts.

For example, on March 21, 2017, 31-year-old Kartheepan, a worker at the Sterlite plant, lost his left hand after it was sucked into an under-designed conveyor belt. With a year-old infant to care for and a full life ahead, he was certified with 100% disability. Vedanta could have compensated the worker right away if it had wanted to – but it took more than 18 months, an international campaign and a self-immolation attempt by the young man outside the factory gate for the money to materialise.

There is another instance that exposes the company's lack of interest in public health. In 2005, the Tamil Nadu Pollution Control Board directed the company to set up a free hospital with inpatient and outpatient facilities. Such directions are legally enforceable and not optional. In September 2005, the company was served with a show-cause notice for failure to comply with this condition. The hospital has not been built till date.

Expensive, power-intensive

Separating oxygen from air is a power-intensive process, and converting it to liquid more so. Choudhury estimated, conservatively, that Sterlite's plant would need at least 0.9-1.0 KWh (unit) of electricity to produce 1 m3 of oxygen; 10% of this will be LOX and 90% GOX. Sterlite doesn't have a captive use for gas since the smelter is sealed – so the plant will have to use 10 units of electricity to produce 10 m3 of oxygen for a yield of 1 m3 of liquid, and discard the rest. To fill a D-type cylinder, therefore, the plant will consume at least 70 units of electrical energy.

Extrapolating ahead: producing a tonne of gas (with 100 kg produced as liquid) will require a minimum of 700 units. Again, this is a conservative estimate.

As of 6 am on May 25, 2021, Vedanta claimed to have produced 1,653.64 tonnes of oxygen. Of this, 1,491 tonnes of GOX was just wasted. The quantum dispatched for medical use in tankers till date is 150.58 tonnes, which is a tenth of what was wasted.

This is like turning on the air-conditioning for an entire building to cool just one room.

Just the electricity cost for this usable yield of 150.58 tonnes is about Rs 80 lakh – which works out to a power cost of about Rs 500 per cylinder of usable oxygen. Even without adding the cost of filling the liquid oxygen in tankers, transportation, salaries for personnel and workers, consumables, pumping in filling stations and maintenance, the power cost alone is double the retail price of oxygen at a Chennai filling station.

Vedanta has said it will also bring the second plant online to enhance LOX production. If both plants are operated at full capacity, the power cost just for oxygen separation will work out to Rs 50 lakh a day for a yield of 100 tonnes.

As it happens, the Supreme Court has ordered that the oxygen from the plant be given free of cost. This still means, however, that the expenses are high and would still be better directed at small plants located closer to the points of consumption. The plant's operation also stands for a near-criminal waste of electricity and life-saving GOX.

This in turn begs the question: Why is Vedanta willingly incurring such a massive expense?

To see the irony in inviting a company that was shut for poisoning the air and suffocating thousands of people to produce oxygen is also to fathom the real intent of Vedanta's largesse. It is not petty or cynical to question a company offering to produce oxygen during a pandemic: the oxygen situation would be better dealt with if decision-makers had paused to identify the best use of the resources that Vedanta is literally throwing to the winds.

Vedanta's offer remains an empty promise that is inseparable from its intention to eventually regain access to its facility. And disasters continue to cloud judgement, blunt honest critique and prompt knee-jerk responses as sensitivity overshadows sensibility.

BOX

As told to Nityanand Jayaraman by Kanchan Choudhury, professor, cryogenic engineering, IIT-Kharagpur (*slightly edited for style and clarity*):

Copper, steel, zinc and gold production facilities use GOX to enrich air in furnaces or in highly pure form as jets. In such metallurgical extraction, GOX is produced at between 5 bar and 30 bar pressures at the plant level. It is usual for an oxygen plant to produce 5-10% of the capacity as LOX, which is kept as reserve in case the plant shuts down – when it is vapourised and supplied to keep the production on.

The percentage of LOX is decided at the design stage. If, at some point, the quantum of LOX has to be increased, one can do that by reducing some gas production to free up some refrigeration capacity (in case of high-pressure gas only) and activate the stand-by turbine, if there is one, to liquefy some extra oxygen.

It is possible to enhance the liquid oxygen production by some fraction. If someone is producing 35 tpd of LOX out of total oxygen production of 500 tpd, it is possible for them to enhance LOX to some extent. But if they are saying they will convert the entire production to liquid oxygen, I find that hard to believe. It is not possible to convert the total capacity by any manipulation at the plant level.

Of course, external injection of liquid nitrogen (brought from outside) can enhance liquid oxygen production further. However, that is another process altogether. The gas plants are not designed to produce high quantities of liquid. The steel plants that are now supplying liquid oxygen for the

‘Oxygen Express’ are reducing production of gases, including nitrogen, and focusing on liquid oxygen. But they must do this without disturbing the purity of the oxygen in the distillation column and keeping strict vigilance on the operation of the compressor and the heat-exchanger. If some of them have stand-by turbines for cooling, they can operate that too.

But even then the production will be limited by the capacity of the other parts – the compressor, heat-exchanger, the distillation column etc. I can’t just enhance capacity by adding another turbine without caring for other parts. These components work in tandem with other components of the system. It’s like saying, “I want to eat more, so I’m adding another stomach.” But the rest of your body has to be able to cope. If you add an extra stomach, your liver will be overloaded and may not be able to supply the digestive juices. The heart won’t be able to pump, and the lungs will not be able to purify by providing sufficient oxygen to the blood.

All the facilities ought to work in perfect coordination in a process plant in order to maintain the oxygen purity required for medical use.

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P.S.

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