

## **Prevention of unintentional occupational exposure to toxic gases to marginal farmers and laborer**

**Introduction:** Toxic gases are formed inside farm wells, septic tanks, chick farms due to prevalence of anaerobic conditions and decomposition of organic matters. Common sites for toxic gases are farm well, septic tanks, sewers and natural gas operations. Majority of exposures are unintentional. Exposure leads to convulsions, coma and rapid loss of consciousness. Studies across globe have shown that poisoning with toxic gases cause blockade of oxidative phosphorylation during electron transport chain and inhibit various bio-enzymatic processes in our body. These gases rapidly distributes to vital organs like liver, lungs and brain. Later two are very prone to damage due to toxic exposure and gases like hydrogen sulphide ( $H_2S$ ) damages respiratory centre in brain, cardiopulmonary damage leading to instantaneous death in a single breath beyond a threshold limit of around 1000 ppm.

**Primary intended beneficiaries:** Salt farmers, Chick farmers, Swine and Sewage tank sanitation workers where there is high level of hydrogen sulphide leads to death of people concern.

**Chosen problem area:** There are reports of unintentional exposure of toxic gases to salt farmers in farm wells of little Rann of Kutch. This is an occupational exposure. Method to prevent such toxic exposure to farmers and devise a strategy to prevent such tragedies is need of this hour.

**Interaction with beneficiaries and prototype design:** We found that majority of wells are around 5 to 20 feet in depth and 3 feet in breadth. We have not found any fencing around well observed and there were sign of water seepage leading to fragmentation of soil around it. Also there was no arrangement of stairs found in any well. Instead they dug the hole in order to move inside well. It is very risky and there is need of safety belts and proper mechanism which can safely take them out in case of emergency or knockdown in case of gas tragedy or during rescue operation.

On enquiry we found that this is a seasonal problem and they face it just after digging the old well for reuse. They told us about process of digging and closing of well during off season. It appears that after rain there is increase in water table which leads to filling of air pores present in soil. This leads to accumulation and spreading of gases through pipes. They also told this problem subsidise with time and not found in running tube wells. We thought that it might be due to decomposition of organic waste as well as inorganic type of situation present inside the deep bore. They predict the presence of toxic gases inside well by burning flame. If this flame suddenly extinguishes inside well, there is a possibility of toxic gases. This hints towards the presence of Carbon monoxide ( $CO$ ) or  $CO_2$ ; as methane ( $CH_4$ ) and Hydrogen sulphide ( $H_2S$ ) are flammable in nature. This type of gases has also been reported in chick farms, swine farms leading to their low mass due to toxicity. Many times sanitation worker died in septic tanks during cleaning of tanks. This type of episodes can be eradicated by proper installation of aerator and ventilator in such sites. This also leads to increase in oxidation of sewage due to presence of oxidative conditions lowering the chances of formation of toxic gases and hazardous events.

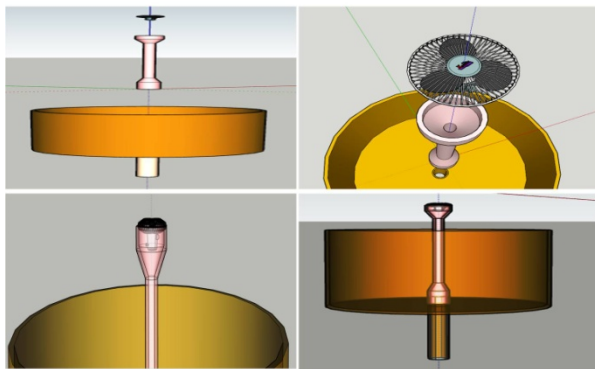
### **Name of people interviewed in Kharaghoda village:**

- Meru Bhai Popat Bhai
- Jagdish
- Bharat Kumar Bhopa Bhai
- Munna Bhai
- Navgadh Bhai Mohan Bhai
- Govind
- Shailesh
- Pratap Bhai
- Dileep Bhai
- Kishan Bhai
- Raju Bhai Rama Bhai
- MV Patel
- Prahlad Bhai Nanu Bhai
- Narayan Bhai Soma Bhai Padaliya

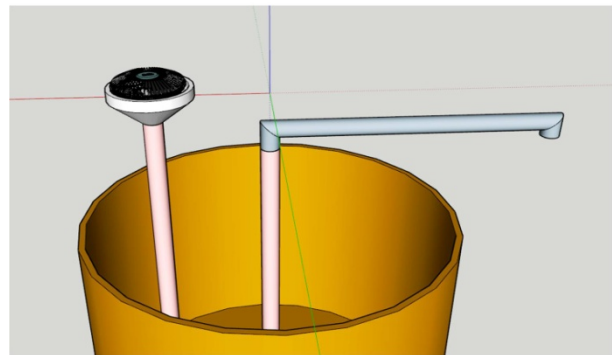
### Proof of Concept/ Prototyping

In order to circumvent this problem, we rely on aeration and ventilation of well in a swift manner and propose our concept. The local people participated and have given critical comments about its feasibility, durability and what are the local solutions available for its fabrication. We refine our approach after this discussion and ideate again to fabricate a prototype. Next hurdle was how to develop this at their native place. On further corroboration with end user it appears that there is requirement of ventilator in offseason (June to October), peak season (October to May) and for chemical analysis of gases there is a need of proper sampling mechanism at safe site.

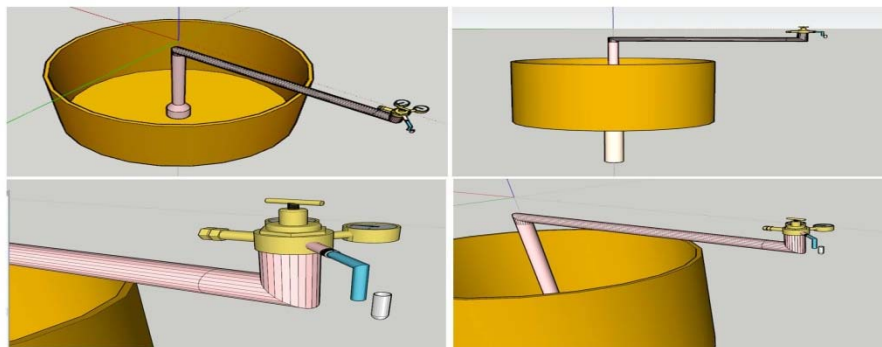
**Different orientation of our ventilator design**



**Ventilator attached to wall of well during brine extraction**



**Design of gas regulator and sampling device**



**Potential of our ventilator in field for field use:** This is cost effective, easy to use. Our ventilator can be used in conditions where there is high level of accumulation of toxic gases which leads to casualties in our country. These are sewage tank, chick farms, swine farms and in tube well during rainy season. This ventilation approach will prevent the tragedy and protect the marginal people from unintentional exposure. Also our regulator design will also help in slow release of gases in a slow manner to avoid any type of blast and help in sampling of complex mixture of gases under laboratory conditions. It will prove boon to their life.

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