Some Barriers to Clean Technologies

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ABSTRACT

Traditionally metallurgical industries have been using unclean technologies and the need for clean technologies cannot be over emphasised. There has always been a gap between technologies of production and those handling the environmental problems arising out of the production methods. The gap needs to be narrowed, and if possible eliminated by changing production technologies themselves.

There are barriers to clean technologies because of a wide-ranging factors: technical, financial, administrative, psychological etc. This article deals with some of the non-technical factors and attempts to identify approaches that may be more fruitful.

Key Words : Clean technologies, metallurgical industries, barriers, non-technical issues

INTRODUCTION

Environmental problems are now reaching crisis proportions and the polluting industries have come under increasing pressures to adopt either clean technologies or close down. Metallurgical industries have been, traditionally, amongst the polluting ones and, therefore, they are often threatened with closure. This poses a problem for the Government and the Society because the same industries continue to provide significant employment and play an important role in the development. The country cannot simply close them down and opt for other cleaner industries as some advanced nations have done.

There are many barriers to having clean technologies. In one extreme end is non-availability of a technology and, in the other, opposition to one readily available. Within these two extremes there are uncertainties of many hues which act as barriers. The following list summaries some of these barriers.

a) Non-availability: An off-the-shelf clean technology is one which is readily purchased and installed. Often such a technology is just not available.

b) Economic non-viability: There may be a technology but it may not be economically viable for the industry.

c) Incompatibility : The clean technology that is available may not be compatible in terms of existing scale of operation, raw materials, process, products, layout, legal requirements etc.

(d) Other non-technical barriers: These include problems arising out of socio-economic conditions, psychological factors, administrative and union problems, fixed mind-sets, lack of awareness, lack of competition, unethical and/or illegal escape routes, legal entanglements, lack of incentives as well as punitive measures etc.

Two most important factors comprise poor subjective horizon and inadequate legal system for implementation of 'polluter pays' policy. An industry always aims at short-term benefits and has, because of the narrow vision, a short subjective horizon. Even if a clean technology is to pay in the long run, there will be general reluctance to adopt it. As regards legal measures, often they have proved counter productive as is discussed in some detail later in this article.

Consider three stories, which illustrate some of the preceding problems. They are self-explanatory and, therefore, need no elaboration.

(a) One young agricultural engineering graduate went to visit his grandfather who owned and tilled an agricultural land. After examining the land and the crop records he boastfully said, 'Grandpa, I know how to produce four times as much crop from this same land'. The Grandpa replied, 'Grandson, I don't know that much but I have long known how to double my crop. But then .... there are problems.....'

(b) A customer went to a supermarket and laid on the exit counter a number of things he had picked up. The sales-girl painstakingly made a list and totaled the prices. 'Why don't you have a calculator? , the customer asked. The girl merely said, 'Because we don't use a calculator'. After a good bit of time when the customer paid-off, put things in a bag and was about to leave, he couldn't resist, asking, 'But why don't you use a calculator?' The girl replied with a smile, 'Sir, because we don't have a calculator'.

(c) An industry which was worried about huge energy bills contacted a research laboratory about improvements in the process aimed at energy saving. After some preliminary trials the laboratory submitted a proposal and a R&D programme was almost finalised. Then suddenly the industry sent a fax saying that they do not need an improved process. On enquiry it was found that the industry had found another, more reliable, method of receiving lower energy bills.

THE STRESS OF ENVIRONMENTAL DEGRADATION

Pollution arising out of industrial activity necessarily creates stress in the society. Yet it is also a sign of industrial development. In the 19th century England smoke from the chimneys of industries in Manchester and elsewhere were symbols of the empire's dominance. An industry without stress is an outdated undertaking. Thus these environmental issues that now dominate discussions provide a new opportunity to give birth to a new generation of clean technologies for modern times. Many European cities devastated by the World War II have rebuilt themselves to look better than before. Many rivers, cities and industries which were reeling under pollution two or three decades ago in Europe and elsewhere are today spotlessly clean. This is beginning to happen in India also. We see the awareness in Tata Steel's plantation and other programmes aimed at improvement of the environment and NALCO's attempts at improved bauxite mining methods and reforestation. These are, however, exceptions. The small scale units appear to be more of a problem and this will be discussed later.

RESPONSE TO POLLUTION STRESS

The society and the Government are now responding to environmental degradation through enactment of legal measures and the judiciary too has become active in declaring punitive measures. Numerous industries have been closed and many more are threatened with closure. At one time, the Howrah Railway Station also received such a threat. The pro-active policy is to: police, monitor, audit, check, confront, punish, order closure etc. etc. and do 'fire-fighting' continuously. This approach leads to some necessary evasive actions such as the following:

(a) Beat the system

A foundry can stop the exhaust fan when inspectors take samples from the exhaust to monitor particulate emission. The industry can dilute effluents by clean water when samples are to be taken. Solid wastes may be dumped out of sight.

(b) Shift the problems to another place

A hospital can clean itself up completely by dumping all clinical wastes outside its premises. (In North Bengal a recent epidemic may have arisen out of human tissues being dumped openly in roadside areas). Vehicular pollution in a city can be reduced introducing electric vehicles but this merely shifts pollution to the electricity generating points. One has to examine the problem at a macro-level.

(c) Oppose on legal grounds

An industry threatened by punitive measures often may be forced to seek legal protection and consequent delays to buy time since our legal system depends so much on records and interpretation of terms, legal matters can linger on for years unless the Government enforces action unilaterally.

(d) Exploit the widespread corruption

It is unnecessary to write more about this.

COUNTER PRODUCTIVE MEASURES

Strong measures are often counter productive and they can create more problems than what they solve. If a polluting industry is closed down then many lose their livelihood. Death from hunger or even suicides are often reported. If pollution is a health hazard and need corrective measures then so does unemployment. Closure of industrial units has a domino effect and it can also lead to law and order problems, political instability etc.

Alternative approach

An alternative approach, which may be run in parallel and which is definitely a superior option, would be to emphasise rewards and incentives for environment friendly measures taken by the industry. It is true that there are a few awards for some big industries which implement environment control measures. Yet rewards and incentives are a few and far between.

The reward system, in general, is lacking in the Indian ethos where individuals in authority enjoy implementing punitive measures. They only know what is bad. No financial audit or administrative review ever identifies positive results as they focus exclusively on things that they can criticise. The obsession with fault-finding can reach absurd lengths. And, of course, positive results are routinely ignored as mundane things. Any school student who is routinely caned for wrong doings and never ever appreciated for achievements and efforts is bound to become a delinquent.

How counter productive deterrent actions can be should be learnt from experiences of the population control offensive which was launched aggressively in this country a quarter century ago and which caused the programme immeasurable harm. Vigilance against corruption has faced a similar fate because policing can never work when the culprits exceed a certain number. Efforts are necessary to ensure that the number of law breakers are below the threshold and this is possible only through positive response - in this case through education, employment and incentives for the law abiding. Today the guilty enjoys an advantage and there is no motivation for the not guilty. This underlying lacunae in our social system needs to be understood by our planners and administrators. A middle path is the best path.

ADJUSTMENT TO STRESS

If a system is stressed suddenly then it is likely to resist and reject the stress so as to stay without it. It is said that if a frog is dropped in a pan of hot water then it jumps out immediately. If the stress is applied gradually then the system reacts slowly and in that process may try to accommodate the stress. Thus if the water is to be heated slowly with the frog in it, the frog, it is said, constantly tries to adapt to the rising temperature and is generally boiled alive before it eventually decides to jump and escape. Something like this happens when you drop a weight on a spring. The spring reacts and the weight may be thrown out as soon as it hits the spring. If, however, the spring is to bear the load set on it quietly, it continues to sag and after a while may be deformed permanently. This phenomenon of creep is well known to metallurgists.

A steel pole may withstand mighty blows from a hammer but may well bend under the minor tension of a clothesline after months of supporting a line full of wet clothing.

Living organisms adapt to changing circumstances. In the Sundarbans, wild pigs and monkeys have learnt to drink salty water. The famous Royal Bengal Tiger also occasionally drinks the same water if compelled by non-availability of sweet water. It also eats the pig and the monkey and it is said that the extra salt may have given it the characteristic aggression.

When there is widespread environmental degradation then humans may also learn to adapt. After all, mosquitoes become immune to DDT and pests become immune to insecticides. It is possible that ragpickers would develop immunity to a wide range of things while a laboratory researcher will stay delicate and far more vulnerable.

What such adjustment will do to the human system in the long run is, however, debatable. Constant exposure to pollution do certainly affect human anatomy, the organs and may be even the brain. Therefore, if one is to sustain the present civilisation then one has to adopt clean technologies as far as possible with inevitable compromise with the country's developmental needs.

Time bound programmes

Enforcement of clean technologies and environmental measures is thought to be better achieved by imposition of strict guidelines and stressful enforcement. If long periods for change - over are allowed then corrective measures are seldom undertaken in earnest because time dilutes the sense of urgency. The enforcement agencies have always faced the dilemma which is well illustrated by the vehicular problems in Delhi. The author believes the problems have intensified because of over emphasis of punitive measures.

Le CHATELIER'S PRINCIPLE

This beautiful principle that was first proposed for chemical systems well apply to social system too. The principle, which is neither a scientifically derived theory nor a law, merely states that if a stress is applied on a system at equilibrium then the system tends to undergo a change which eliminates the effect of the stress.

Consider the synthesis of ammonia from nitrogen and hydrogen. As is well known, the reaction is exothermic and it results in contraction in volume. Thus if there is equilibrium between hydrogen, nitrogen and ammonia, we can shift the equilibrium by creating a stress by changing the temperature and/or pressure. Higher pressures as well as lower temperatures imply more ammonia and the shift in equilibrium tends to reduce the stress imposed.

It is widely believed that Le Chatelier's principle applies equally well beyond chemical systems. When the body feels cold it shivers so as to generate heat and a foreign particle entering a nose causes sneezing. Both the body reaction may be compared to restoration of equilibrium. Consider some other examples.

(a) If two neighbouring countries generate stress and disturb equilibrium by stockpiling of arms then there will be a war so as to restore the original equilibrium.

(b) When a nation loses men in large numbers in a war then there follows a period of baby boom for restoration of population.

(c) If there is sudden influx of money in the hand of customers such as the Puja bonus and the demand – supply equilibrium is disturbed then prices go up to undo the effect of the stress.

(d) If the Government becomes too oppressive then the population revolts to restore freedom etc. etc.

Now consider the question as to how will a society change to restore equilibrium when the pollution stress crosses a threshold. There can be conscious and unconscious reactions. The former comprises closure of industries or introduction of cleaner technologies. As has been mentioned previously, the latter is still unclear. The words 'sudden' and 'gradual' are ambiguous in cosmic time scale. The sudden disappearance of the dinosaurs some sixty five million years ago spanned hundreds of years. Environmental degradation and its effects have been felt only since the beginning of the last century and the period may be too short for a noticeable corrective response in nature. Some scientist speculate that global warning may be a repetitive phenomenon. Warming will cause appearance of vegetation in many areas now barren or snow covered as well as longer periods warmth for better growth of vegetation. This will take care of increased CO_2 levels and bring about cooler climates once again.

As regards the mankind, man is only one of the living organisms on earth and health problems of humans caused by pollution certainly do not merit any automatic response from the ecosystem. If man is not sufficiently concerned to restore a cleaner environment then the earth would not bother either. Actually the picture is more complicated because there is simultaneous stress form other sources, such as population explosion and social upheavals, incoming of a life style so very different from those of stable communities of the past, widespread use of medicines many of which have considerable side effects, intolerance and terrorism etc. Environmental degradation is interconnected with the problems arising out of the others.

THE GAIA HYPOTHESIS

If we are to expand the time scale then we can understand the Earth's response to changes in the environment in terms of a brilliant hypothesis given by James Lovelock, an independent researcher and inventor. Lovelock was fascinated with the puzzle popularly called the 'Goldilock's Problem' which relates to the question as to why Venus is too hot for life, Mars too cold whereas Earth, which has an orbit in-between the orbits of these two planets, has just the right conditions?

Lovelock proposed the Gaia Hypothesis (pronounced Guy-ah and named after the ancient Greek Earth Goddess), which proposes that our planet acts like a giant living organism in which all living things interact and maintain stability. There is some

powerful self-regulating system at work[1]. We need to study Earth as doctors diagnose and treat patients, not as isolated leg or ear but as a whole living being. He says that to understand pollution we need not be Environmentalists but Enviro-physicians.

How Gaia works is understood from the following example. When life was emerging on earth, the atmosphere contained 98 percent CO_2. This caused super greenhouse effect but the planet did not become superhot like Venus (surface temperature 425°C as against Earth's present average of 15°C) because living things made the difference – bacteria removing from air CO_2 – 3.7 billion years ago algae produced oxygen. Around 2.5 billion years ago oxygen produced could no longer be consumed by chemicals from the eruptions and it started accumulating and cooled the earth by reacting with methane. The Earth thus goes through periods of heating and cooling.

The question now is whether Earth can survive vast amounts of pollution. As has been mentioned earlier, it should – but with unforeseen changes. May be new species will emerge which are pollution resistant. This response to environmental stress is akin to Darwinian evolution with no conscious plan or intelligence. It is just that 30 million species in the world life has enormous resilience.

MANAGEMENT OF CHANGE TOWARDS CLEANER TECHNOLOGIES

Coming back to the subject matter proper one needs to think of clean technologies in order to sustain our civilisation and development and eliminate available dangers. Industries can no longer discard indiscriminately fly ash, red mud, residues, sludges, slags, effluents, smoke and exhaust gases because the society at large is becoming increasingly reactive. The so-called development is actually leading to degradation. There are reliable studies which show that in the 90's while the Gross Domestic Product (GDP) grew at around 5 percent in conventional terms it was actually about – 5 percent if one is to account for the cost of remedial measures to restore land and forests, human health, water resources etc. to the original levels. One cannot estimate the cost of loss of bio-diversity. Factors that come in the way of clean technologies have been listed earlier. Some measures that may induce adoption have also been discussed. Some essential points that relate to management aspects are now presented.

One may assume that the industry dislikes change and must be coerced, controlled and directed towards clean technologies by various methods discussed earlier. Some industry may even prefer to be treated thus to avoid responsibility. However, the assumption may not be valid and the industry may have genuine intrinsic interest to change, be self-directing, responsible and creative. Yet, the industry may not be able to change due to various reasons.

The Government, academia, research institutes as well as social groups need to initiate dialogues and participative management. Not long ago the old mind set resisted change and the following expression were common:

A good idea but ... * Against our policy * Too much ahead of time * Good in theory, but ...* Costs too much * It won't work * Needs more study etc.

[1]Readers Digest, February 1991, p. 42.

But times are changing and environment management is becoming a mandatory part of many company budgets (10 percent will be a good figure). To make every employee become more environment sensitive one can recommend the following measures.

- Maintain open channels of communications
- Encourage contacts with outside sources
- Arrange awareness programmes
- Make budget provisions and hire environmentalists
- Be open to new ideas and implement them
- Take long term views
- Assign some non-specialists to problems etc.

The last point is specially important. Not all solutions lie with the experts. This can be illustrated rather well by referring to improvements achieved by athletes.

Experts have introduced special programmes of nutrition, exercises for strength, stamina, speed, endurance, dietary supplements, medication, mental exercises, motivation and all that. There is bio-mechanics – the study of body in motion to identify in minute details what slows down which motion to reduce performance levels. This helps athletes fine tune their performance. Yet some revolutionary ideas have come from athletes themselves.

Until 1968, all high jumpers had a choice of only two styles – the scissors kick (hopping over the bar with rear end down) or the forward roll (straddling the bar face down). Dick Fosbury, a gangly adolescent once intuitively invented a lazy looking style by approaching the bar with his back and jumping vertically backwards. He surprised himself by jumping some eight inches higher than his usual and eventually this relatively unknown jumper won the 1968 Olympic Gold in Maxico city. That style, known now as Fosbury Flop has immortalised him since most higher jumpers now employ only this style which initially seemed to go against basic theories of biomechanics. The centre of mass of a jumper rises to a height determined by the energy generated by the muscles. In the conventional styles this stays within the body. In the flop style, however, when the body clears the bar in an arch, the centre stays outside the body and lower than the bar. When there is a problem, the man in the shop floor can suggest an idea that eludes the expert. Eventually, inspiration, motivation and cooperation make change more likely than coercive measures.

CONCLUSIONS

Although there is crying need for clean technologies, there remain barriers to their implementation. There are a variety of reasons which create difficulties: technical, financial, administrative, psychological etc. To achieve desirable changes coercive measures may be necessary. Yet best results should come by focusing on improvement in the management of the industries and incentive schemes.