MATERIALS INDUSTRY: ECONOMIC AND ENVIRONMENTAL ISSUES: AN OVERVIEW
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Abstract
Pakistan has not been able to utilize its precious mineral wealth for its economic growth and development, despite having comparatively strong mineral base. The development of material industry is critical and can play a vital role in the economic growth and competitiveness of a country. This demands focused efforts to improve and develop new materials and put to proper use the existing ones. Industry especially materials industry faces a plethora of challenges to its development. This presentation covers various economic and environmental issues at policy, strategic, technical, operational, research and academic level that are hampering the development of material industry. An attempt has been made to highlight issues in major material industries e.g. ceramic, plastic, marble, steel, cement, glass, pharmaceutical etc. The issues will be analyzed in global and local perspectives using different ranking indices manifesting the slow and low development of materials industry. Information like contribution to GDP, employment generation, export potential, in addition to touching the status of the industry from knowledge utilization point of view. The relevant discussion is based on literature review, personal experiences and interaction with industrialists, government officials, and environmentalists and above all the drive from the Pakistan materials society. Keeping in view the current global economic recession, this study is an attempt to create awareness about the crucial role that materials industry can play in economic revival of the war on terror torn society of KPK in particular and Pakistan in general.

Key words: Materials vision, environmental issues, economic issues

1. Introduction
Economic development of many countries owes a lot to the proper and productive use of mineral resources. Pakistan despite being rich in minerals has not been able to use it to its advantage. Development of Materials-based industry gives developing countries like Pakistan an economic edge. On the contrary the history of materials industry development of Pakistan has been a chequered one and has faced a plethora of challenges. The lack of awareness and poor knowledge base and political priorities are parts of the spectrum of challenges facing the sector. Whereas elsewhere the development of new materials has changed the complexion and pace of economic growth Pakistan is still groping with the question whether there is a need to invest in the materials industry? For the development of new materials, greater emphasis is on property attributes of materials, such as efficient design, high strength to weight ratio, lower energy consumption and higher value addition in production. The availability and improvements of existing technology and development of new technology are critical for the development of new materials. However, the critical ingredients for the development of this
activity include a strong base for research and development (R & D), qualified and skilled manpower, and availability of raw materials, financial resources and relevant infrastructure. For some times the need was felt for a forum that could provide a platform for stakeholders to join forces or at least to discuss the issues that impede the development of the materials industry and in the process seek real world solutions to the issues. Pakistan Materials Society housed in the Materials Research Laboratory, University of Peshawar has taken the lead. This write-up is based on the review of literature, personal experience of working with the industry and with the industrialists and environmentalists in an attempt to at least highlight some of the environmental and economic issues that bedevil the development and growth of materials industry.

2. National Development Vision
The national vision firmly reveals that beneficiation and development of new materials is critical for economic growth and competitiveness. The development of new materials has changed the complexion and pace of economic growth in sectors like transport, energy, sports good, engineering, defense and electronics (Siddiqui, 2010). Some of the aspects that need to be focused in the development of materials include:

a) Resource Issues in the Development of New Materials
• greater emphasis need to be laid on the property attributes of materials
• efficient design
• high strength to weight ratio
• lower energy consumption

b) Resource evaluation and exploration
• Vast mineral resources have not been benefitted from
• Geological mapping is a prerequisite to materials development
• Mapping improves profitability & reduces the element of risk for new investment
• Currently, only 33% area of Pakistan has been mapped for mines and minerals

c) Human resource
• Availability of appropriately trained manpower
• Development of educational institutions
• Up to date curriculum
• Qualified teaching and research faculty

d) Technological issues
• Weak technological base
• Unscrupulous import of turn key technologies
• Imported technologies not socially and economically compatible

e) General issues
• Electricity and gas load shedding
• Decrease in production
• unemployment as most of the labor is on daily wages

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Increasing trend in cost of inputs leading to high cost of production
- Imported/Smuggled goods commonly available in the markets at much cheaper prices
- Deteriorating political, law and order situation
- Weak political system means weak policy
- Depreciation of currency
- Priorities of Government

A look at what can happen if nations cannot develop and use its resources; the case of Pakistan is very interesting. The above and many other issues have over the years made Pakistan increasingly less competitive. World Economic Forum every year conducts surveys and evaluates around 12 major and many sub parameters to measure the competitiveness of countries through an index which is called Global Competitiveness Index (GCI). The performance of Pakistan on the index has been very dismal and depressing. In 2007 Pakistan was placed at $87^{th}$ position of 139 GCI countries, $92^{nd}$ in 2008, $101^{st}$ in 2009 and in 2010 at $123^{rd}$ place (GCI, 2010-11). It dropped 5 places in 2008, 9 places in 2008 and heaviest ever fall of 22 places in 2010 showing that Pakistan is losing its competitiveness edge with each passing day and if the law of averages holds true it should hit the rock bottom i.e. 139 position in 2011. The author in his capacity of provincial head of the first ever department of science and technology at provincial level has been highlighting the aspect at a number of forums and had predicted the trend on the basis of his personal experience of the Pakistani working and political environment.

The most pressing issue is the acute shortage of developed human resource both at the technical as well as the paratechnical level. In early 1980s UNESCO under its program UNISPAR defined countries in terms of science and technology human resource, that a country would be called a developing country if it has 1200-1400 scientists and engineers per million of population (National S&T policy, 1984). S&T professional personnel in 2009 was 207 per million of population for Pakistan. Status of Pakistan presents a tale of woes. It has never ever been anywhere around the yardstick of the early eighties and the figures are for 2007. The pathetic progress in terms of growth of S&T and R&D establishment over the years respectively substantiate that HRD has never been government priority and investment approach has been into other economic sectors.

Other indicators are equally frightening. On HDI Pakistan is $136^{th}$ out of 177 countries, $93^{rd}$ out of 111, exports $63^{rd}$ of 196, GDP per capita $135^{th}$ of 182, $93^{rd}$ of 111 in quality of life and 22 out of 170 in military funding (Economic & Social Indicators, 2005-06; The World Factbook, 2010). The focus is very visible from these indicators. National Innovation System is less functional and there is disconnect to a certain extent in the three pillars of the system that is Academia, industry and government. The three contributory factors of the many are communication deficit, technological deficit and relevance deficit.

3. Case studies
In the light of the above a couple of materials-based industrial sectors are analyzed for economic and environmental issues.

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a) Steel industry

i) Technological issues
Pakistan has around 430 tons of iron-ore reserves (as per the evaluation done so far). Very interestingly the production technology in steel industry needs high quality iron ore (raw material for steel), not available indigenously. For this purpose Pakistan has to import the raw material which renders the available iron ore unusable as it requires up-gradation and beneficiation of available resources which is a costly venture. The issue can be resolved through R&D by developing technology which can utilize the available iron ore. The change in technology will reduce the import bill on raw materials; will lower the steel prices thereby boosting the local industries. The reduction in the cost of production will also have positive impact on downstream industries. Corex technology can be quoted as one such technology which is being used in South Africa and Korea (Faruque, 2001).

ii) Production issues
- Low labor productivity
- Steel production hampered through power
- Recent Management crises
- Inconsistent policies resulting in poor investor confidence as portrayed by the failure of privatization
- Importing iron ore, iron and steel scrap cheaper than mining local ore a capital-intensive venture
- Production process is not environment friendly (i.e. not implementing innovative process technologies that reduce emissions and wastages, sludge and dust)

iii) Environmental issues
- Heavy air pollution
- poor quality of scrap bundled
- Operation of the induction furnace produces metal dusts, slag and gaseous emissions
- 12 Kg of particulate matter produced per ton of product
- Primary hazardous components of furnace dust are zinc, lead, and cadmium (composition and contents vary with the scrap quality & furnace additives)

So the trick lies in the change in technology. Now this is a decision that can be taken at the policy level and should be politically backed which can guarantee the growth of steel industry.

b) Plastic industry
At the national level Plastic material is the 4th largest item of import i.e. 70-80% raw materials are imported. Against the global growth rate of 7.5, Pakistani industry is growing by 15% per annum. There are around 6000 manufacturing units with 600,000 people directly or indirectly involved. The tremendous growth of the Chinese products and its penetration into the market both at regional as well as global level has made the situation even worse. Despite the large contribution to the economy, the Industry is largely unorganized and scattered. One of the reasons for large import of the raw plastic material is the lack of research and development in the country (Islam, 1991).

i) Policy issues
- Vision and planning
- Traditional design and no innovations
- Globalization and free trade
- High custom duties on Raw material
- Lack of financial assistance
• Tariff on high impact polystyrene has been reduced to 10 from 25% hurting the local industry
• Intellectual property and copyright laws are not strictly enforced
• Raw material is subject to maximum tariff and highest custom duty of 20% in addition to 17-21% sales tax
• Finished goods have been subjected to low tariff which clearly encourages imports rather than exports
• Waste exported to China and returns as valued added as plastic utensils

ii) Environmental issues
• Non biodegradable
• Plastic bags especially recycled black bags
• Choking of drains
• Lowering the productivity of arable land
• Additives used in processing health hazard
• Burning releases dioxin – a class of 75 chemicals which is carcinogenic and causing birth defects and cancer

Existing KPK industry picture is a dismal one in backdrop of the government policies, global rescission, Afghan war and now global war on terror which is fought in Pakistan. Currently out of 2274 industrial units only 590 are in operation contrary to 1640 units before 9/11. Up till 2007, 1500 units were in operation, mostly in marble, ceramics and plastic sectors. Out of which 317 are closed in district Swat only which does not include the number of cottage industrial units that got closed. Only in Bunir 177 marble units got closed. The reason being the war on terror which was fought in Swat in particular and Malakand in general (Personal Communiqué).

4. Academia-Industry-Government Roundtable (AIGR)
In a bid to help the national innovation system work KPK Department of Science and Technology (DoST) constituted a high level Academia-Industry-Government Roundtable in partnership with the then Sarhad Chamber of Commerce and Industry (SCCI). The then Governor NWFP (now KPK) became the Patron-in-Chief of the forum. The main purpose of the forum was to create and promote synergies between academia and industry for commercialization of R&D indigenously carried out in a bid to offer solutions to the industry at the local level. This was leap frog towards assisting the government of KPK in its shift towards knowledge-based economy. A meeting of cluster heads of the industry was called to prepare a statement of issues in the SCCI. The idea was to make the research in industry market driven and the researcher can conduct real world research. This interaction facilitated by Government was aimed at reducing at communication deficit and create synergies between the two pillars of the innovation system. For this purpose, R&D fund was established in the DoST (AIGR, 2009). The following statement of issues was prepared in the first meeting of the industrial cluster heads:

a) Statement of issues
• Energy being the No.1 issue to be focused upon
• Emphasis on the design of efficient machinery which can reduce power losses
• 30% power losses occur within industry which can be minimized
• Improve the existing machinery by redesigning
Environmental issues caused by the industrial wastage  
Alternate energy source for the industry can be a good R&D project  
Waste disposal  
Continuity of R&D projects need to be assured  
An experiment was performed for replacing the natural gas consumption in the industry by blowing powder coal into furnace, the experiment failed. (Causes might be due to the ratio of oxygen & powdered coal including the pressure with which the coal was blown into the furnace)  
Reduce power requirements of a blower by redesigning its components  
Replace the existing system by "Fluidized Bed Technology" India is already using that technology.  
Efficiency of the furnace needs to be improved by reducing heat losses  
Losses in stack of a furnace  
Modification of mechanical components for better performance (Reverse Engineering)  
Wear resistant materials need to be designed & developed for the industrial machinery

This list of the issues and problems both environmental and economic is not exhaustive and all the industries particularly materials based have their own set of problems. The above facts and figures clearly highlight the importance of materials and their role in economic development and should find a priority place in the scheme of things in the Government. The provincial industrial policy and all the other relevant policy documents should lay special emphasis on the natural wealth and its use for socioeconomic development.

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