Technology Issues in Pakistan's Leather Tanning SMEs

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Introduction

The roots of Pakistan's leather industry can be traced from the 'silk route' era. Today this industry thrives in many aspects as a truly indigenous industry with its contribution only second to the cotton textile industry. The leather sector contributes around 5% to GDP and 7% to the total exports of the country (SMEDA, 2003) which is a reflection of its contribution to the national economy. Despite the importance of this sector in the national economy, the sector is facing severe technology management issues. In Pakistan, although the growth and expansion of Small and Medium Scale Industries (SMEs) is generally constrained by a number of technology management related problems, yet the problem is more severe in the leather and tanning industry the reason being, lack of efforts towards product and process technology management and integration aspects in the leather tannery industry. This paper examines the technology issues in leather tanning and to a certain extent leather products industry. The main focus is on major players in the tannery sector in and around Karachi, Lahore, Multan, Kasur, Faisalabad, Peshawar, Gujranwala, and Sialkot. Over 725 tanneries are located in and around these areas (Ghani, 2006). The information on the industry has been obtained through interviews with industry experts, published data, and through an opinion survey questionnaire. The research is focused on raw hides to leather and leather products sub sectors along the value chain covering the whole production process. Leather and leather products industry has been viewed as a series of encompassing activities along a value chain model and the problems faced in relation to technology integration along this value chain have been investigated. The value chain of the leather industry stretches from the point of raw hides and skins to finished leather and final products. The paper however, primarily concentrates on raw hides and skins to finished leather production process and not on any specific product category. Furthermore, the focus is on management of technology rather than on the engineering aspects of technology.

The following issues are addressed in this research.

1 Assessment of the present technology status in the leather industry with special emphasis on the tanneries sector.
2 To provide solutions to the major technology management problems faced by the leather industry.
3 Assessment of the current status of pollution created in the processes of tanning raw hides and skins.
4 Assessment of the potential of Pakistan leather industry and the initiatives required to reach the potential.

Leather and the World market

Leather enriches human lives in numerous ways. In

the developed countries, almost all of which are located in the frigid North, leather jackets, trousers and suits have long been a status symbol. Same is the case with leather upholstered furniture and the lavish interiors available only in top-of-the-line luxury cars. This status of leather as a luxury good has been made possible primarily due to the induction of state-of-the-art treatment and tanning technologies to give leather a never-before-possible thickness, unlimited colour variations, luxurious feel, and silky touch. This has also transformed leather into a comfortable material to work with as any other fabric for any or all of the uses mentioned above.

Leather Industry in Pakistan- Current Scenario

The main leather product categories originating from Pakistan include footwear, leather garments, leather gloves, handbags, purses, key chains, file covers, briefcases, wallets, sports goods, and accessories In some niche markets, Pakistani leather garments have a unique place(Aslam 2000; Shabbir, K 1995; Vasuko,R 1994). Around 60% of domestically produced leather is consumed by footwear industry and another 30% is shared equally by leather garments and upholstery industry, and the rest is consumed in leather gloves and bags, etc (Leather Research Institute, 2004).

The leather industry of Pakistan can be categorized into micro/cottage, small, medium and large scale. Most of the tanneries however are in the medium scale category. All together, over 2500 tanneries are scattered all over Pakistan. Direct employment generation from this industry is over quarter of a million. The Trade Development Authority of Pakistan estimates that contribution to overall exports is around 7% (2003 export value US $ 694 million) which accounts for 80% of local production (SMEDA 2003). The share of Pakistan in the global leather market is around $ 0.6 billion (3%) out of the total $ 20 billion. Leather in Pakistan is primarily sourced from over 725 small and medium size tanneries located in Karachi, Lahore, Multan, Kasur, Faisalabad, Peshawar, Gujranwala, and Sialkot (SMEDA 2003). These tanneries are operating in both formal and informal sectors, and some operate as industry clusters.

The leather tanning industry produces about 6 million hides and 36 million skins annually (Ghani, 2006) through abundantly available local raw material base of cattle: cows, buffaloes, sheep, goats, camels, asses, horses, and mules. Meat is a staple food in Pakistan. According to an estimate by Pakistan Skin and Hide Merchant Association, a staggering figure of 7 million animals of different kinds and hues, worth Rs. 80 to 90 billion were slaughtered on Eid Al-Adha celebrated on January 1, 2007 (Amir Latif 2008). The website also reports that heifers are more in number of animals sacrificed as seven devout can share in the sacrifice of a camel or a cow as an act of worship. These figures testify the position of Pakistan among top list of nations in terms of possession of raw material base. It is apparent that the industry is not utilizing its full potential. The reason being the perception of low in quality and low in value addition. This problem is more severe in the leather foot wear industry. Leather garment sector is performing relatively better with more value added product range. Both the leather footwear and leather garment sector have problems of their own. Shoe manufacturing requires huge capital investment in terms of plant, machinery, labour, and marketing, while garment manufacturing requires investment in inventory. It requires about 2.5 square feet of tanned leather to manufacture a pair of shoe; whereas the manufacture of a leather jacket requires some 40 square feet of tanned leather (SMEDA, 2003).

Research Methodology

The industry is rich in human embedded practices and information with a long history. The research required a more qualitative approach. It was evident from the interviews that there were diverse ideas and thoughts, which could be better captured through an interviewing process rather than through a survey questionnaire.

The interviews involved personnel across many areas in the industry such as managers of tanneries, persons in up and down stream of leather industry, SMEDA, Pakistan Tanners Association, Pakistan Export Development Bureau, Ministry of Industries and Production, Leather Research Institute, relevant personal

in the provincial government, chemicals and machinery suppliers, and environmental enforcement authorities, etc. In the search of global best practices, the information collection was restricted to published literature, the internet, and interviews conducted with the industry experts in Pakistan.

Value Chain and Modeling of the Process

The value chain of the leather industry stretches from the starting point of raw hides and skins to finished leather to the final products such as footwear, leather garments, and other leather products. This study however concentrates mainly on raw hides and skins to the finished leather production process.

In the analysis of technology status of this industry, a simplified version of the Porter's value chain model was adopted. Porter (1985) refers to the industry value chain as being composed of nine generic activities which are linked to each other and to the activities of its suppliers channels, and buyers. The value chain can be divided into two broad types of activities: primary activities, which involve the physical creation of the product, its sale and transfer to the buyer, and after sales service; and support activities, which support the primary activities by providing purchased inputs, technology, human resources, and various firm wide functions (See Figure 1).

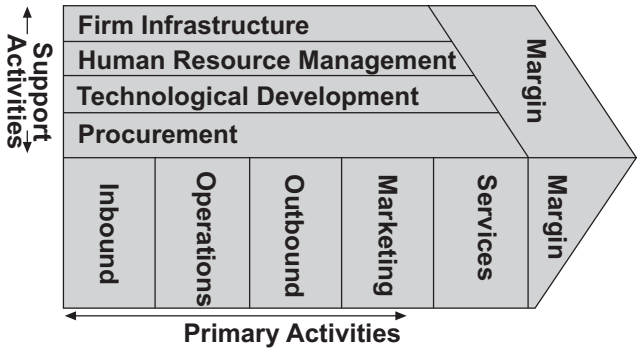

Figure 1: Value Chain Model (Porter 1985)

Since this research was concentrated within the internal operations of the leather production process, especially tanneries, the concept of primary and support activities as represented by Porter's value chain was used in order to model the value creation process with the technology components. The primary activities of the leather industry comprises of Pre-Process, Pre-Tanning Process, Tanning Processes, Wet Finishing Process, Dry Machining and Finishing stages. These activities were incorporated in a simplified model as shown in Figure 2. These stages were then further broken down into sub-levels to identify the sub-processes and activities in each stage. The technology components in relation to each of these were identified in relation to the best practices. The best practices were identified using bases such as expert opinion, literature, interviews, and observations.

Technology Defined

Westphal (1982) defines technology, "as a collection of physical processes which transform inputs into output together with the social arrangements (i.e organizational modes and procedural methods) which structure the activities involved in carrying out these transformations". Smith (2002) clarifies that technology is less defined by the items it produces than by the body of knowledge it comprises. Technology Management, in this context, as noted by Narayanan (2001), focuses on the development of technological capability and its implementation or deployment in products and processes guided by the strategy of the SME to accomplish the goals.

The up and down stream activities of the Pakistan leather industry encompass an accumulated knowledge and information of tanneries, factories with heavy to light machinery, man-machine interfaces, and organizational procedures governing the overall operations. Technology in leather industry can be visualized to include a variety of all the knowledge, products, processes, tools, methods, and systems employed in the creation of leather and leather related products. Thus, the most appropriate way of viewing technology would be technology in terms of its embodiment form (Ramanathan, 1983, Khalil, 2000). This allows technology to be viewed as an embodiment of its components namely: techno-ware, human-ware, info-ware and orga-ware (or hardware), software, and brain-ware including know-how. Techno-ware consists

of tools, equipment, machines, vehicles, physical facilities, etc. Human-ware refers to experiences, skills, knowledge, wisdom, creativity, etc. Info-ware includes all kind of documentation pertaining to process specification, procedures, theories, observation etc. Orga-ware consists of management practices, linkages etc facilitate the effective integration of Techno-ware, Human-ware, and Info-ware. (Ramanathan 1990, 1994). Sharif (1993) states "All four components of technology (techno-ware, human-ware, Info-ware, Orga-ware) interact dynamically and are required simultaneously for the successful performance of an enterprise or industry. The relative importance of the four components of technology depends, however, on the type of transformation and operational complexity. Also, due to the existence of interactions and trade-offs among the components, similar outputs (in terms of technology content added) can be produced by different combinations". When the concept is extended beyond geographical boundaries to other countries this difference is more evident. The research on technology issues in the Pakistan leather industry is based on how each component of technology is involved in the value creation process.

Leather Manufacturing Process

The chrome tanning method is the most widely used process in Pakistan's leather sector. Vegetable tanning method and a combination of both chrome and vegetable tanning are also used in some tanneries. The production process consists of a number of steps involving the application of large quantities of water and chemicals to the raw skins. Some refer to it as a recipe. About 130 different types of chemicals are used in leather manufacturing process ranging from inexpensive common salt (sodium chloride) to expensive Chrome Sulphate. Leather manufacturing process consists of following major steps (Khan, Munir A 1996):

- Pre-Process
- Pre-Tanning Process
- Tanning Processes
- Wet Finishing Process
- Dry Machining
- Finishing

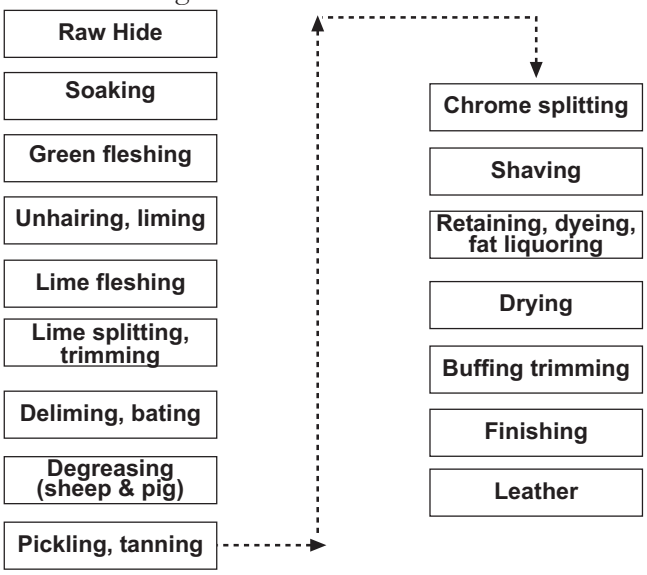

Figure 2: Flow of leather processing

In pre-processing, skins/hides are received and salt is applied on the flesh side of the skins/hides, skin trimming is done to remove unwanted parts. After pre-processing, the pre-tanning process starts with the soaking process in which skins are made flaccid by soaking them in water. After soaking, the hair is removed, lime is used for the dehairing process. Unwanted flesh is removed with the help of fleshing machines after the liming process. To prepare limed skin for tanning, the skins are de-limed using Ammonium Sulphate and then are washed. Bating is done for further purification of the hide. As a next step, degreasing is carried out with the help of detergents.

Tanning process starts with pickling which is the treatment of skin with acids and salts to bring it to the desired level of pH. Tanning may be defined as the treatment of skin for preservation. Chrome tanning uses Chromium Sulphate as a tanning agent. Tanning process stabilizes the collagen network of skin. After tanning, skins are called wet blue and are stored for sometime and thereafter they are sorted out according to quality. If hides of cows or buffaloes are being used for leather manufacturing, these are sliced to get desired thickness. This process is not carried out on the skins of goats, camel or sheep. Thereafter, the hair side of the wet blue is shaved to give the desired thickness. In

order to give desired softness, color, strength, and quality to the leather, wet blue skins are processed further through a wet finishing process. A fat liquoring process is carried out to impart desired softness and dyeing is done to give it a colour. After wet process, different drying processes are carried out to dry the processed leather. These processes consist of smaying/setting, vacuum drying, stacking/toggling, buffing/shaving, nailing/trimming, pressing, and segregation of the leather. Finally, finishing processes are carried out to impart durability and beauty to the leather.

The process technologies described range from high, low, modern, emerging, medium, appropriate, codified and tacit, etc and its relationship is visible with the scale of activity in a firm. Full process automation comparable to that of Italy does not exist in Pakistan. The tanneries in and around Korangi areas inspected by the authors are more labour intensive and their perception about technology is merely confined to machines. Other components of technology are either ignored or there is a definite lack of awareness.

Tool and Equipments and Chemicals Used in Leather Industry

Compared to the other industries, tools and equipments used in the Pakistani leather industry are very basic. The use of complex technology in terms of tools and equipments in the leather industry is minimal and most of them are used as supplement to labour intensive activities. Most of these are locally produced. Lahore is the main centre for manufacturing of these tools and machinery. Some items are also imported from South Asian countries and China. Main tools and equipment used are soaking pits, liming pits, fleshing beams, various types of boilers, samming table, shaving machines, scissors, movable trestles, spray guns, compressors, hair removing knives, cutting knives, poles and drums, iron work facility, band knife splitting machine, slickers, buffing machine, spray booth, treatment plants, etc. Almost all of these tools and equipment, though also imported, can be manufactured in Pakistan because only simple expertise and technology is required. Leather industry uses more than 130 types of chemicals in various stages of the production process. Important ones can be listed as: acetic acid, chrome syntan, fat liquor, sodium format, sodium bicarbonate, ammonium bicarbonate, basic chrome, formaldehyde, wattle extract, emulsion drums, pigments, ammonia, acrylic syntan, formic acid, etc. Most of these chemicals are imported. Considering the availability of raw materials some of these can be easily produced in Pakistan.

Issues in Technology and Technology Management

Product and process technology issues are multi dimensional and their root causes are complex. These issues are classified as under:

- Outdated Technology
- Lack of Innovation and New Product Development
- Poor mechanism of technology sourcing, transfer and integration.
- Inadequate Marketing Support
- Lack of clear-cut leather policies at national level.
- Environmental pollution.

Outdated Technology:

Pakistan has a rich tradition of manual skills in tanning and leather technology passed on from generation to generation. Thousands of skilled artisans practice these skills especially in making of shoes and jootis in villages and small towns catering to the local population. Some of these skills have made their name popular at regional levels. Names as Kasuri jootis, Pathan chappals from Peshawar which are known even across the borders. There has been hardly any radical change over decades in the design or technology. On the contrary the craftsmen take pride in informing the potential customers that their skills have been practices for are generations. There is a need for realization that many changes have occurred in the world of technology. Industry practices have changed. Large organizations have entered the field challenging the small artisan. In the current dynamic and turbulent environment, industry survival and growth depends on appropriate change

in work practices which should match the world practices.

As Pakistan had built up a reputation of being a good reliable supplier of semi-tanned leather, many tanners have had the foresight to seek technical know-how, by sending their family members to study leather technology in the UK and other parts of the world. Thus beginning a process for discovering a route to a desirable future. Subsequently, some modernization of leather industry took place in 1970. At the same time relocation process of the leather industry within the city of Karachi to the Korangi industrial area saw the development of various joint ventures with foreign partners. This infused new vigor and ambitious strategies evolved to produce fully finished leather and leather products rather than semi finished ones from 1980 onwards. This initiative was however limited to a small proportion of tanneries. Furthermore, no serious attempt was initiated to develop a brand image of any Pakistani leather product. Becoming partners in outsourcing and taking contracts to supply goods in someone else brand resulted only in small value addition and smaller returns.

Most of the persons interviewed, held the view that technology means machines. Only a few acknowledged product design, training of operators, control on wastages, improvement of quality as the other important dimensions of technology. Productivity, plant utilization, levels of capabilities, throughput cycle, core competencies are also directly related to technology which needs to be acknowledged.
Need of Technology for the leather industry can be studied in the context of two segments; convenience goods and fashion products.

Convenience goods: Shoes constitute quantitatively the largest segment of leather goods. Being a necessity for everyone, this product has a high market potential. This is the reason for the stiff competition in this product category both from local and foreign producers. Considering the competitive environment in this product category these types of products therefore must be produced at low prices and should have a lean supply chain system. 'Large batch size' results in economy of scale, provided there is an appropriate automated/mass production technology, management controls, and infrastructure. China recognized these concepts and took initiatives towards achieving economies of scale a decade ago, and has as a consequence emerged as the manufacturing hub of the world. Automation technology is the need of the hour in each product category. Automation also creates consistency in quality, planned schedules of production, low wastages, high plant utilization and high productivity. This however, requires major investment in infrastructure. This also requires retraining of workforce on new skills to work on automation and computerized controls with the emphasis being less on manual skills and more on analytical skills. There are also associated problems in areas of sourcing, transfer and integration of technology, which are discussed in the sections to follow.

Fashion products: This product category covers a section of shoes for gents, ladies footwear, garments, gloves, ladies purses and others. The leather goods that have entered the world of fashion, require innovation in terms of new designs and new product development. Customers are willing to pay a premium price for exclusively designed products. In this product category, the product designs survive for a short duration and undergo change quite often. The industry needs frequent product design innovation which requires a higher component of manual skills, which is abundant in Pakistan. Automation is not the requirement. The machines and the equipment is required for general purpose wherein the plant can switch over to alternate design of the product or even a new product without a major change in tooling and set-up. The emphasis is on adapting and to produce fast to meet the schedules set by fashions which last only for a short while and get replaced when a new design appears from a competitor. Supply chain lays emphasis on time. An SME has to be prepared for a risk of uncertainty of demand, and unsold stocks in case the forecasted sales are not achieved. Additional aspects related to this demand are discussed in the section on Innovation.

IT and other related technologies such as ERP, CAD,

CAM and databases hardly find a place in the current technology. Justifiably, there is hardly any role in the present set up. However, as and when there is automation and a demand for innovatory designs, the IT enabled tools will become a necessity. Most western nations increasingly demand for online trading transactions and designing. There is therefore the need to the same adopt at the local level. Use of IT in Pakistan is still at a secondary stage due to very low level telecommunication and related infrastructure. Effective stock controls depend on timely availability of information. In addition to this, the Pakistan leather industry is resistant to adopting new ways and means of improving efficiency and does not use the potential of ICT innovations.

Innovation/New Product Development: Bellon and Whittlington (1996) refer to innovation as a change introduced into an economic process which has the intention and effect of enabling a more efficient use of the available process. Shumpeter, J (1926) provides a classic definition that innovation is the successful introduction into market of a new product, new process or new organizational model. Since innovation involves moving away from the tried and tested standard, innovation therefore involves risks. Bellon and Whittlington (1996) however point out that for an SME, risks of not innovating are also large and devastating. The first risk lies in rapid change of market. An SME can meet this challenge only when it is ready to introduce a new product at the right moment and right price. The second risk, involves the gradual reduction of its technological edge of the business leading to a consequent reduction of its market share. This risk is also met through the introduction of new innovations on consistent and regular basis. The third risk lies in the probability of an enterprise losing its niche market to the competition. The response to this risk lies in the preparedness of the organization to create yet another niche market on the strength of its innovations.

There is wide diversity in innovations. Therefore it is necessary to examine innovation in the context of its brand classification. Frequently used classifications of innovation are: Radical, Technological, and Incremental. Incremental innovations are of the small variety and occur continuously throughout the course of the production. These are the 'daily' improvements. Radical innovations call for new capabilities, knowledge, and skills. These are generally based on multi-disciplinary approaches for which expertise from several specialists has to be brought together. Other than large investments and long time span for results, there are two other considerations. Technological innovations are the result of several radical innovations occurring at the same time resulting in the birth of new products/services. These are the outcome of sustained research efforts. R&D capabilities are determined by attitudes, orientation for advanced education, and a motivational incentive different from that practiced in business oriented production set ups. These are not part of the environment characteristics in which an SME operates. Secondly, as Bhavani (2006) states, technological innovation involves a high degree of uncertainty and risk which an SME is not equipped to undertake. A radical innovation also leads to changes in existing skills, core competencies, and organizational methods; it also leads to changes of machines, facilities, tooling, process quality systems, software, and controls. The risk is that the existing investments in these areas may become obsolete. It is therefore in areas of incremental innovations, however, that an SME can develop core competencies to develop capabilities of fast-cycle product development linked to customer needs.

Innovation is vital for fashion products and for many seasonal products used in cold climates. The business for innovative products is set to increase in coming years, as more and more people demand differentiation and a tendency to avoid being grouped as 'me too'. The introduction of new designs and new products is therefore vital for sustaining the business.

This does not imply that there have been no initiatives towards capacity building in this area. Setting up of Computerized Pattern Designing Centre in Sialkot, introduction of computerized designing courses at Vocational Training Institute (VTI) in Sialkot, and the establishment of a Common Facility Centre for computerized pattern designing at Vocational Training Institute Sialkot by SMEDA in collaboration with

Punjab Vocational Training Council (PVTC) are a few very interesting developments. But these are not enough for an industry of this size and importance.

Technology watch, sourcing, transfer and integration

The prime objective of technology watch is to ensure an early detection of external developments in areas of product and process technology that could have an impact on business. It is in this area that Pakistan leather industry sadly lacks. SMEs which constitute the bulk of industrial units in this sector do not have the resources to carry out the watch, as well as, collect information. The responsibility for the technology watch has to be shouldered by a professional body or a research organization. Acquiring and transfer of technology poses another set of problems. Any arrangement has to ensure an association on long term basis so that benefits of ongoing research also become a part of the transfer. Furthermore, the association should also lead to the establishment of in-house research facilities.

Technology integration mainly deals with the integration of various technologies used at various stages of total supply chain of leather industry. Technology integration should therefore begin from the ground level which is livestock management to produce good quality raw skins/hides. This includes development of animal husbandry, slaughter techniques, skin removal methods and skin treatment methods. It is necessary that all developed technologies should be available at one door, and that the appropriate technologies need to be promoted as required by the tannery owners. Most of the tanneries are reluctant to change their traditional way of operation. This is not unusual. When an industry has had traditional set of operations over generations, there is strong resistance and reluctance to change with new developments. Due to this attitude, it is difficult to introduce new chemicals, technologies, systems and procedures, work and management practices that are more efficient, and environmentally and socially friendly.

Inadequate Marketing Support

Pakistan is a major source of supply of leather products produced for the brands of foreign houses. It has become a center for 'outsourcing' of leather goods for multinationals or fashion houses. There is hardly any worthwhile initiative from either a private entrepreneur or a government undertaking to undertake global marketing of leather goods. Consequently, the nation in its 60 years of existence, with advantages of raw materials, inherited skills, a long history of human embedded practices in its people, and naturally inclined hard working artisans has neither been able to produce either a product brand or an image of 'Made in Pakistan' for its leather products at the global level. Most of the well known foreign brands are currently exploiting Pakistan leather under their brand names at a cost which is only a small proportion of their ultimate realized sale price from the consumer.

Absence of clear cut National policies

Pakistan is a natural land for the small scale sector. It is a land where craftsmanship and skills have been inherited and passed on for generations. The artisanship is evidenced in cotton and silk textiles, carpet weaving, wood engraving, furniture making, marble and stone work, earthenware, pottery, metalwork, and leather work. The last of these has also demonstrated its potential to generate jobs for millions and to generate foreign exchange next only to the textile sector. This sector alone, because of its breadth of availability of raw materials can create a balanced development throughout the country. The national priorities arising of teeming unemployed, massive illiteracy, and large underdeveloped areas clearly direct the need for encouraging the leather industry. As a natural corollary, the national policies should call for encouragement to the small scale sector and provide support where the small entrepreneur lacks resources. Such areas related to leather industry are clear and well defined. National initiatives are needed in providing advice on product and process technology, provision of financial subsidy for upgrading of technology, establishment of research and product development centers, centralized pollution waste disposal systems, and the development of support mechanism for access to international markets.

Environmental pollution

Production of leather basically involves soaking (beam

house), tanning, dyeing, drying, and finishing. Most of the leather produced in Pakistan is chrome tanned. The effluent that needs to be treated in the leather industry is primarily related to the soaking beam house, and tanning operations. The effluent most difficult to treat is that from the tanning process. All wastes containing chromium are considered hazardous by the U.S. Environmental Protection Agency (EPA). There are many other pollutants involved in the processing of leather which are also associated with environmental and health hazards.

The most reliable source on Pakistan's leather tanning industry's environmental implications is the ETPI (Environmental Technology Program for Industry) Project (1999). This study provides bench mark for local tanneries to comply with National Environmental Quality Standards (NEQS) in place of obtaining ISO14000 status which enable them to produce environmentally clean products. There are quite a few research studies on this issue (Rajamani.S, 1999, Rajamani.S et.al, 1999; Ravindranath.S and et.al, 1999; Chattha and Shaukat, 2003) which discussed the environment hazards in the leather tanning process. The leather manufacturing process essentially produces three types of wastes: liquid wastes, solid wastes and polluted air (Dasanayaka.S et.al, 2005).

Liquid wastes: The quantity of water usage in tanneries varies from one tannery to the other, but in all the tanneries there is wastage of water as compared to the level specified by Pakistani Environmental Authorities. Many factors contribute to this variation which include non-availability in some areas and abundant supply of water in other. The industry benchmark for water usage is 50-60 lit/1 kg skin processed. However, studies in this area indicate that water consumption in Pakistan tanneries is about 150-180 Lit/1kg skin processed. Most of the tanneries currently discharge their waste water into the local environment without any treatment whatsoever. Tannery waste water is highly contaminated and most of the comparative parameters reach as high as three-to-four times the limits established by the National Environmental Quality Standards (NEQS) of Pakistan.

Solid wastes: Tanneries generate high amounts of solid waste in the initial stages of skin preparation. There is also a high sludge content present in the wastewater. This amounts to 50-75% of the original wastewater content. Apparently, this sludge if allowed to settle down, can be disposed off as solid waste. Solid waste include raw trimmings, wet trimmings, dry trimmings, wet shaving, dry shaving and buffing. Table 1 shows the general content of solid waste in a tannery. It may be noted that most of the solid waste generated at the tannery is consumed by various scavengers. Poultry feed manufacturers and glue manufacturers are the most common buyer of solid waste. This is a source of concern to the poultry consumers because some of the waste contains chromium, which is a serious health hazard.

Polluted Air: There are two major air emissions produced by the tanneries in Pakistan. These are one, emissions from generators and boilers, and two emissions of other types which include emission from the chemicals used in the process and burning of skin hairs. Generator emissions and boiler emissions have been tested and found to be at generally acceptable levels by authorities. However ammonia emission during the washing processes, and sulfide emissions during the discharge of acids and alkaline materials together have serious health concerns. Table 2 shows the possible mitigation measures for leather tannery activities (Khan, R. 2002).

Conclusions and Recommendations

The leather industry in Pakistan has the potential for substantial growth in the coming decades as it can emerge as the most important export-oriented industry provided suitable steps are initiated at various levels to bring changes in technology being used currently and technology management.

Pakistan requires both types of technology i.e automation technology, and technology with roots in innovation. Technology based on automation will produce standard design products in large volumes, at low cost, and consistent quality. It will bring in the use

of concept of lean management to allow Pakistan to emerge as the manufacturing hub of leather shoes in the world.

Technology with roots in innovation, and in-house R& D is needed to develop product designs, process technology, and new applications of leather, on continuous basis to meet the demand of innovative products for gifts, for fashion, and forever growing demand of section of customers who desire to be differentiated. Purchase of product designs from foreign based houses cannot provide stability to the industry. This type of technology will also create immense employment for the artisans of the country. The industry will prosper without having to uproot the artisan from their towns and villages. The artisans will produce goods to the designs supplied by a central agency.

The current pathetic ambiance and highly irresponsible image of an industry producing a high degree of pollution has to undergo drastic changes. With international society getting progressively more concerned about social issues, the industry may face a deluge of legal cases from within the country and the possibility of a ban imposed on exports by environment conscious importing countries. The case of carpet weaving can be cited as evidence. The introduction of national and regional level laws and the creation of enforcing regulatory authorities without introducing proper environmental management technology and systems will have a negative impact on the industry. SMEs suffer from lack of resources and technology to set up individual waste disposal and pollution control systems. The new technology on pollution control has no provision of open disposals. The disposals have to be treated. The sludge is required to be removed, and water made available for use and reuse after treatment. The trade bodies such as Tanneries Association have to take up the responsibility to set up common facilities. Government can assist and setup state of art effluent treatment plants in areas where environmental problems exists and can charge the industry of their usage.

A national policy is needed to consider Leather industry as the thrust area for Pakistan's socio-economic development. Updating of technology is the foremost step in this direction. Investment in tanneries and leather sector depends on the leather product sub-sector activities. Therefore, tanning and leather industry should be considered as a part of integrated supply chain of leather industry. Networking should be promoted among the Sialkot, Lahore, and Karachi sectors where quality and standard leather products are being produced and exported. Promotion of joint ventures with foreign leather manufactures, setting up of incubators, joint programmes with universities, and setting up of training centers could be other steps. An initiative is needed to promote a brand with focus on world market. The government can prove to be a catalyst.

In the long run, the industry will have to develop its own discipline to reduce costs and improve productivity and train employees. Machinery, chemicals, and other raw materials are all being imported. There is a scope to produce the same internally to save on costs. A large number of the chemical used in the leather industry are derivatives of petroleum. Unfortunately however, most of the petroleum and gas in Pakistan is consumed for energy generation rather than for the manufacturing of value added chemicals.

References

1) Amir Latif, (2008), Udhiyah Skin Funds Pakistan Charities, , retrieved on 5th December, 2008.
2) Aslam. M (2001), 'The booming leather industry' By Syed M. Aslam, June 04-10, 2001. http://www.pakistaneconomist.com/issue2001/issue23/contents.htm
3) Bellon, Bertrand, and Whittington, Graham (1996) Competing Through Innovation: Essential Strategies for Small and Medium-Sized Firms, Oak Tree Press, Cork, Ireland.
4) Bhavani, T.A (2006), Globalisation & Indian Small Scale Industries, Ane Books India, New Delhi

5) Chattha. A and Shaukat. M (2003) An Assessment of Environmental Concerns in the Leather Industry and Proposed Remedies: A Case Study of Pakistan.
6) Dahlman, Carl and Larry Westphal (1982). "Technological Effort in Industrial Development' in Stewart, Frances and Jaffrey James (Eds). The Economics of New Technology in Developing Countries. London:Printer Publishers, pp105-137
7) Dasanayaka. S, Attalage. R and Nakandala. D (2005) Analysis of Success of Technology Transfer at Leather Industry in Sri Lanka. Paper presented, Second International Conference, Siri Jayawaradanapura University, Sri Lanka 2005 March. ISBN 955-9054-47-3 ,pp 375–386,
8) ETPI Project (1999), Responding to Environmental Challenge, Pakistan's Leather Industry, A Brochure, Federation of Pakistan Chambers of Commerce and Industry Karachi, Pakistan.
9) Ghani.E (2006), 'The Pakistan's Leather Industry' in PIDE/HEC, Technology Based Industrial Vision and Strategy for Pakistan's Socio Economic Development, Govt. of Pakistan, Islamabad, Pakistan
10) Khan, Munir A. (1996), "Leather Treatment, Chemicals, Dyes, Environment, Leather Processing, Design of Leather Good and Machinery". Prime Minister's High Power Committee on S&T, Sub Committees Reports (Manpower/Software/Defense etc.) Vol.8 to 19, Govt. of Pakistan, Islamabad.
11) Khan, R (2002), Environmental Impacts and Mitigation Costs of Cloth and Leather Exports from Pakistan, Sustainable Development Policy Institute, Karachi.
12) Khalil T M (2000), 'Management of Technology : The Key to Competitiveness and Wealth Creation' Mc-Graw Hill.
13) Leather Research Institute (2004), "Problems and Solutions" Pakistan Council of Scientific and Industrial Research, Karachi
14) Narayanan,V.K (2001).Managing Technology and Innovation for Competitive Advantage, .Pearson Education Inc.pp8.
15) Porter, Michael E (1985), Competitive Advantage: Creating and Sustaining Superior Performance. The Free Press, New York.
16) Ramanathan K, 1990 'Management of Technology: Issues of Management Skills and Effectiveness ' International Journal of Technology Management 5 (4) (pp 409- 422)
17) Ramanathan K, 1994, 'The Polytrophic Components of Manufacturing Technology' Technological Forecasting and Social Change (pp 221-258) Elsevier Science Inc
18) Rajamani. S (1999) "Biotechnology Reduction of Sulfide in Industrial primary Wastewater Treatment System – A Sustainable and Successful Case Study" Proceedings of International Conference on Cleaner Production and Sustainable Development'99 December 13-17, 1999, Taipei, Taiwan R.O.C. PP. 139-146.
19) Rajamani. S, Suthanthararajan.R and Ramaasami.T (1999) "A Successful and Sustainable Industrial Scale Chromium Recovery and Reuse System in Tanneries" Proceedings of International Conference on Cleaner Production and Sustainable Development'99 December 13-17, 1999, Taipei, Taiwan R.O.C. PP. 332-338.
20) Ravindranath.E, Suthantharajan.E et. al. (1999) "A Generation of Bio-energy in the Treatment of Tannery Wastewater Adopting Up-flow Anaerobic Sludge Blanket (UASB) System" Proceedings of International Conference on Cleaner Production and Sustainable Development'99 December 13-17, 1999, Taipei, Taiwan R.O.C. PP. 316-321
21) Responding to the Environmental Challenge: Pakistan's Leather Industry. www.cpp.org.pk/etpibrchr/brochure-leather.pdf
22) Schumpeter, J (1929), Theory of Economic Development, George Allen and Unwin, London.
23) Sharif. N 1993 Technology Management Indicators for Developing Countries, Published in TDRI Quarterly Review Vol. 8 No. 2 June 1993, pp.17-24
24) Shabbir, K (1995). "Leather Industry in Pakistan" Pakistan & Gulf Economist. 28 January - 3 February 1995, pg 6.

25) SMEDA (2003), "Pakistan Investment Guide". Experts Advisory Cell, Leather Sector of Pakistan, Ministry of Industries & Production, Islamabad ,
26) Smith, Cooper, (2002) Technology Strategies, Prentice Hall PTR, NJ.
27) Vasuko. R (1994) "Pakistan Leather Trade Seeks Aid As Exports Slump, Factories Close". Journal of Commerce. 16 June 1994.

Table 1: Composition of Solid Wasted Generated from a Typical Tannery

Type of Solid Waste	Rate of Generation	Characteristics of Solid Waste	Remarks
Dusted Salt	0.1 kg/skin	Contains around 120 gm/kg of moisture, 120 gm/kg of volatile matter, 450 gm/kg of salt.	Contaminated with blood, hair, dirt and bacteria. Partly reused in curing and the rest is indiscriminately dumped in undeveloped lands near the tanneries.
Raw Trimmings	0.024 kg/skin	Proteins	The skins are trimmed (especially at legs, belly, neck, and tail parts) in order to give them a smooth shape. The trimmings are usually sold to soap and poultry feed Production units.
Fleshing	0.25 kg/skin	Contains around 240 gm/kg of proteins, 30 gm/kg of fats, 15 gm/kg of chromium oxide	After chrome tanning, skins or split hides are shaved to proper thickness. This operation produces solid waste containing chrome. Secondary users including poultry feed manufacturers usually collect these shaving from the tanners.
Dry Trimmings/ Dry Shaving/ Buffing Dust	0.06 kg/skin	Contains around 300 gm/kg of proteins, 130 gm/kg of fats, 30 gm/kg of chromium oxide	Secondary users, including poultry feed makers, collect cuttings and dry trimmings and buffing dust of the leather from the tanneries.
Assorted Refuse	No consistent quantity	Primarily cartons, bags, drums, etc.	This is normally sold separately (in bulk) in the retail market.
Wet Trimming/ Wet shaving	0.14 kg/skin	Contains around 240 gm/kg of proteins, 30 gm/kg of fats, 15 gm/kg of chromium oxide	After chrome tanning, skins or split hides are shaved to proper thickness. This operation produces solid waste containing chrome. Secondary users including poultry feed manufacturers usually collect these shaving from the tanners.

Source: ETPI Survey, 1999

Table 2: Mitigation of Environmental Issues

Issue	Treatment method
Water conversation	Converting continuous washing to sequential washing
Use of environment friendly chemicals	Weak organic acid could replace ammonium sulfide; trivalent chromium could be used instead of hexavalent chromium; Enzaimatic biodegradable products could replace sulfides, surfactants etc.
Green fleshing of hides	Green fleshing, just after deep soaking will result in pH neutral wastewater, this will increase chemical penetration into skin and save on lime usage.
Hair shaving methods	Changes in the processing methods could lead to reduction in COD and BOD considerably.
Recycling lime	Lime wash water could be reused few times before discharge. This could save on lime, sulfides and water.
Lime splitting & trimming	Splitting & trimming is generally carried out after tanning. If this is done in the pelt, non-tanned products could be readily used at the feed preparation.
Oxidation of sulfides	Use of hydrogen peroxide or sodium hydrogen sulfite will oxidize the sulfide and avoid formation of hydrogen sulfide.
Finishing process	Use of roll coating machines instead of conventional washing machine could reduce water usage by 45%. Also proper air ventilation systems could reduce emission inhalation by workers.

Source: Authors