

Study to design and develop an entrepreneur model: perspectives from tannery industry in Oman

Ahm Shamsuzzoha¹, Mohammad Khadem¹, and Sujan Piya¹
Department of Mechanical and Industrial Engineering
Sultan Qaboos University, Muscat, Oman
¹ *corresponding author*

Abstract

Tannery industry is considered as one of the major growing business segment around the world. This industry occupies a promising place in the global market place due to its enormous export, growth and employment opportunities. In Oman, currently there is no tannery industry, which can be established with the objective to diversify its economic growth outside mostly oil-based industry. This study therefore, explores an opportunity to design and develop of an entrepreneur model from the perspective of tannery industry in Oman. In order to develop such entrepreneur model, necessary data were collected from various regions within the Sultanate of Oman. In addition to develop such the model, this study also considered the total leather production system starting from collecting the raw materials to all stages of treatment and finally physical distribution to the market.

1. Introduction

Tannery industry commonly known as leather industry is considered as one of major industry around the world. The leather industry occupies a promising place in the global economy in the perspective of its enormous export, growth and employment potentials (Gangi and Timan, 2013). For maximizing the returns and improving the utilization of the raw materials, there needs strategic planning and development of this industry.

There are many definitions for the leather tanning process, which carry the same goal. According to Wikipedia: "Tanning is the process that converts the protein of the raw hide or skin into a stable material, which will not putrefy and is suitable for a wide variety of end applications". On-the-other-hand, the Columbia University Press defines it as a process by which skins and hides are converted into leather. Therefore, tanning is the process through which rawhides and skins are converted into leather as a final usable and sellable product (Nazer et al., 2006). It is used as the basic raw material for the production of various leather commodities (i.e. shoes, bags, etc.). Actually, there is no absolute procedure for the leather production. Raw material (hides, skin) and the final product needed decide on which techniques to be used (Zhang et al., 2016). There are several techniques of tanning but the most common are Chrome and Vegetable Tanning (4). The tanning process usually passed through several steps, which can last from as short as a few minutes or hours to as long as several months for some kinds of vegetable tanning techniques.

The term 'hide' in the tanning industry is used for the skin of large animals (e.g., cows or horses), while skin is used for that of small animals (e.g., sheep). Hides and skins are mostly by-products from the slaughterhouses, although they may also come from animals that have died naturally or been trapped and hunted. Tanning industries are usually located near the regions where high amount of raw material is available. However, hides and skins may be preserved and transported prior to tanning (Balkau and Scheijgrond, 1996; Sumita et al., 2015).

This research study explores the idea to establish leather industry in Oman. In this avenue, the paper explores the possibility of establishing complete leather industry in Oman from collecting the raw materials and ending up with commercial leather products through all stages of treatment and finally physical distribution to the market. Since

tannery industry is unique in the region, the study will include feasibility study provided with detail economy analysis.

The objective of the study can be summarized as follows:

- (a) To collect the data of livestock in Oman.
- (b) To forecast the availability of raw materials(hides & skins) by analyzing the data.
- (c) To check the feasibility of establishing tannery industry in Oman.

2. Case Study

Gathering information about the leathers of animals in Oman was first concern. Therefore, a first visit to Ministry of agriculture and fisheries wealth was done and an interview with senior statistics specialist was conducted to get the data on total number of animals and its type for nine consecutive years. In addition, the data was also collected to know the concentrated density of animals in terms of various regions in Oman.

Further, visit to Busher central slaughterhouse was conducted and a person was interviewed. He is the assistant director of veterinary services. He mentioned that the leathers are sold for some contractors who export them to Dubai. The data about the numbers of each type of animals and the prices for each month was collected and analyzed.

Finally, it has been communicating with each of the central slaughterhouse in Sohar and Dhofar Municipality central slaughterhouse respectively to get an extra information about the hides in their regions and to do the overall demands.

3. Procedural steps in tannery industry

The procedures those are adopted in a tannery industry are as follow.

3.1 Leather soaking or washing: The first step in the leather production process is soaking of leather, which is implemented by butting the hides in the water for several hours or days. The water will help to remove salt, dirt, blood and excess animal fats and make the next step easier.

3.2 Leather unhairing: This process is aimed at removing the hair from skin by using a blunt knife.

3.3 Liming: This process is done by treating the skins with milk of lime (a basic agent). The hair and impurities make undesirable substance.

3.4 Deliming: Deliming is an operation done in drum/paddle in order to remove the alkali from the hide and minimize the pH of the collagen.

3.5 Bating: This process can be considered as complement of deliming process via enzymatic action. The main purpose of this step is to make the hides more pliable and flexible in addition to loosen the fibers of the skin.

3.6 Degreasing: The skins is not yet usable because it is too rigid and colored by chemical substance so the process are continued to turn it into marketable product. The skins are treated with chemical and mechanical process in the drums.

3.7 Drying process: This process is important to eliminate the water soaked in the previous step by the tanned leather. One of efficient ways to dry the leather is by pressing it between two huge cylinders that rotates and let the skin pass between them in order to squeeze it to the maximum.

3.8 Shaving: In this phase the skin is further smoothened its thickness through its entire surface and getting rid of fleshing residues.

3.9 Split leather: The aim of splitting operation is to produce hides of a specified thickness.

3.10 Stuffing: In this step waxes and fats/oils are added between the fibers, thus giving the leather the flexibility and the softness needed for the various products.

3.11 Drying: The aim of drying operation is to achieve a uniform drying. It is a critical stage of tanning, which should be carefully monitored. The leather must dry slowly and control the humidity well to insure that they remain soft.

3.12 Polishing: It is a type of mechanical finishing operation. The main objective of polishing is to create a shiny surface by scrubbing leather with a velvety wheel.

3.13 Ironing and Plating: In this stage ironing and plating machine supplied with hydraulic mechanisms are used to make the surface of skin smooth. The parts used in machine are lubricated ball or roller bearing and ironing cylinder which has a hardened layer of chrome and it can be warmed to 200°C.

3.14 Embossing: Embossing is the process of applying a design on the surface of leather to create decoration, and it is done by applying certain pressure from the bottom of material.

3.15 Finishing: This is the step of imparting desired texture and color over the leather. There are two groups of materials, which used in finishing.

- a) Binders: Like waxes, synthetic polymers or proteins.
- b) Additives: like pigments to give color, or surface modifiers.

The flow chart of the procedural steps are shown bellow

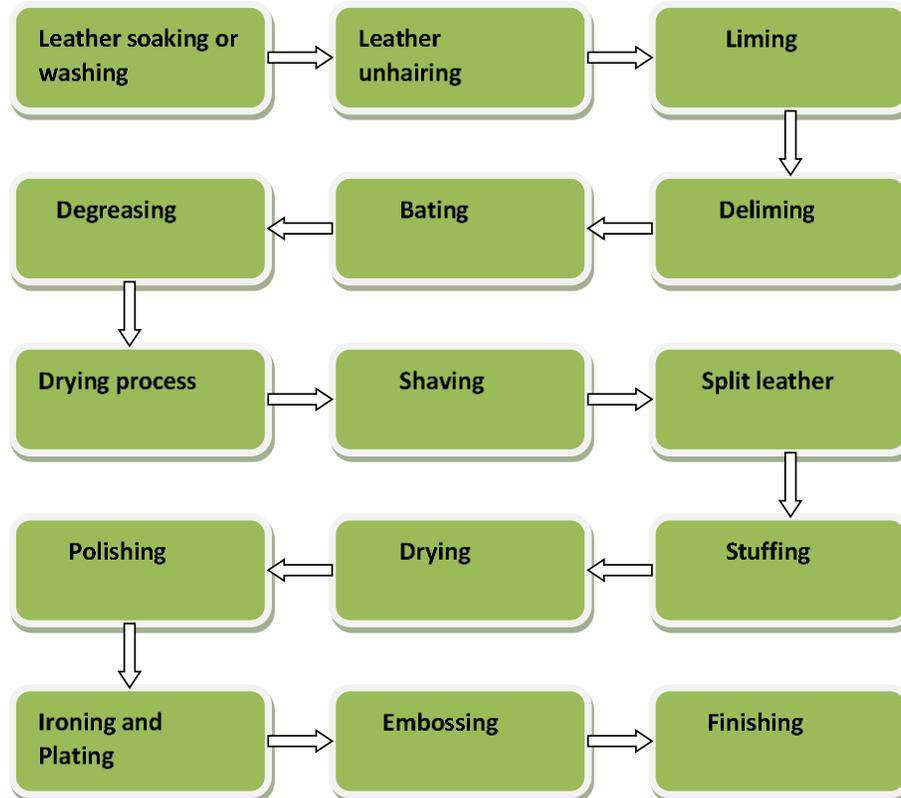


Figure 1: flowchart of procedural steps of Tannery.

4. Collection of data

Two sources were used to collected data on the slaughtered animal to understand the generation of hide or skin per year. One source is from three major slaughter houses in Oman. Next is from the data collection through questionnaire survey with the resident in Oman. Data collection from resident is essential to forecast the number of animals slaughtered by themselves at home.

The data in the following table is in terms of thousand for single unit.

Table 1: Data of livestock in Oman in year 2013

Regions	Cow	Camel	Sheep	Goat
Muscat	5.49	0.469	21.42	74.761
Dhofar	207.89	14.587	14.4	278.499
Musandam	0.333	0.017	12.8	126.02
Al-Dakhilyah	18.063	10.11	54.96	220.78
Al Batinah	90.232	17.92	179.21	490.509
Al-Sharqiyah	17.691	39.03	143.97	545.737
Al-Dhahira & AL-Buraimi	19.804	10.18	100.22	247.026
Al-wusta	1	19.25	21.19	101.874
TOTAL	360.503	111.543	548.17	2085.206

4.1 Slaughterhouses data:

The slaughter animals' number for 2013 is collected from three main slaughterhouses in Oman (Busher, Dhofar and Sohar central slaughterhouse). The following table shows the collected data.

Table 2: Total slaughter animals of main slaughterhouses in year 2013

Main three slaughterhouse	Camel	Cow	Goat	Sheep	TOTAL
Jan	313	2316	11320	1320	15269
Feb	320	2094	10784	1348	14546
Mar	324	1915	12209	1549	15997
Apr	333	1993	11547	1226	15099
May	313	2153	12044	1431	15941
Jun	359	2352	12063	980	15754
Jul	588	2456	22055	1466	26565
Aug	501	2997	17999	2206	23703
Sep	389	1610	10322	707	13028
Oct	469	2505	14845	3868	21687
Nov	274	1634	7489	1307	10704
Dec	413	2004	11931	1313	15661
TOTAL	4596	26029	154608	18721	203954

From the data it is evident that the slaughter of animal is significantly high in the month of July (26565), August (23703), October (21687). This is due to the reason that in the year 2013, these are the months of Ramadan and Eid. However, in the other months, the number of slaughtered animals are almost same and there is not significant difference. From the table it is seen that the highest slaughtered animal is in the month of July (26565) and the lowest is on November (10704) as this month just comes after Eid-UI-Azha. The graphical representation of this slaughtered animal data are as shown below:

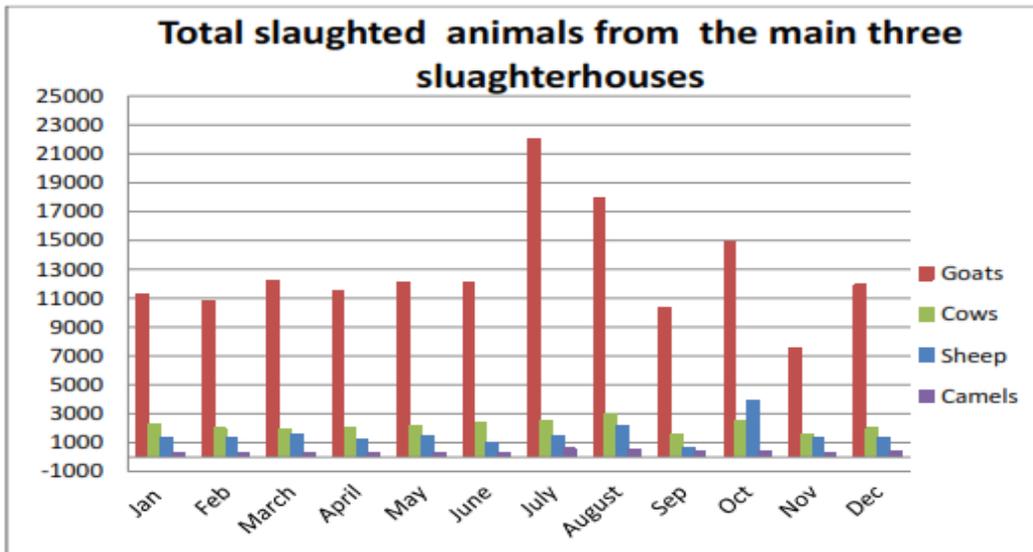


Figure 2: Total slaughter animals

4.2 Data from survey

According to (Oman General Census of Population, Housing and Establishments 2010), the total number of Omani families is 259,000 families. This number has been used as a reference to estimate the total number of slaughtered animals across the Sultanate with the help of the results obtained from surveys Furthermore, numbers of each animal type is obtaining by applying the percentage of each type from the surveys to the total number. According to the survey, there are 62% of families slaughtering animals by themselves. Therefore, only this percentage of families will be used to calculate the total raw materials generated from slaughtering animals. In the survey, 70% of respondent have answered that they slaughtered two or more animals each year. Based on it, the demand will be calculated by considering two slaughtered animals per family. Therefore, the total number of possible hides that can be collected from families is:

- 259000 (total family) * 0.62 (percentage of families that slaughter by themselves) * 2 (number of slaughter animals for each family) = 321160 animals
- Going back to survey's results, 30.5% of the total slaughtered animals were sheep, 36% were goats, 27% cows and 6% were camels.

Thus, the equivalent number of each type of animal can be obtained as follows:

- $0.305 * 321160 = 97954$ sheep
- $0.36 * 321160 = 115618$ goats
- $0.275 * 321160 = 88319$ cows
- $0.06 * 321160 = 19270$ camels

The total demand is finally obtained by summing up the average slaughter animals by families that has been calculated from surveys plus the total number collected from the main slaughterhouses. The demand of each type is as shown in Table 3.

Table 3: Total demand of families plus slaughterhouses

Demand	Camels	Cows	Sheep	Goat	Total
Slaughterhouse	4596	26029	18721	154608	203954
People	19270	88319	97954	115618	321161
Total	23866	114348	116675	270226	525115

5. Feasibility Analysis

A feasibility study aims to objectively and rationally uncover the strengths and weaknesses of proposed venture, opportunities and threats present in the natural environment, the resources required to carry through, and ultimately the prospects of success. In its simplest terms, the two criteria to judge feasibility are cost required and value to that may be gained. In the case analysis we compare between the total cost and the total expected earnings. Total costs constitute of all the machinery and equipment required according to the procedural steps as discussed in section....It also considers all the other fixed as well as variable costs.

5.1 Total cost

Table 4 shows the fixed and variable costs for starting tannery industry. The first part of Table....shows the cost on capital investment and the latter one is annual expenses.

There are two kind of costs for every industry.

5.1.1: Capital Investment (Building cost, Machines cost, Vehicles cost, Consultant cost).

5.1.2: Annual Running Cost (Raw materials cost, Rented land cost, Labor cost, Water & electricity cost, Insurance cost, Transportation cost, Maintenance Cost, Administrative & development cost).

5.1.1: Capital Investment

a) Building cost: The building cost is shown in Table 4.

Table 4: Building cost

Building Type	Required Space (m ²)	Cost (US \$/ m ²)	Total (US \$)
Manufacturing building	8000	208	1664000
Warehouse	2000	208	416000
Administrative offices	1000	312	312000
Parking area	2000	104	208000
Furniture & miscellaneous	–	–	104000
TOTAL	–	–	2704000

b) Machines cost: To run the industry 24/7 the required machines cost are as bellow.

Table 5: Total machines cost

Name of Machines	Price Per Unit (\$)	Quantity	Total (\$)
Leather washing and soaking machine	2000	12	24000
Leather unhairing and shaving machine	68000	3	204000
Lime skin machine	68500	3	205500
Wax milling drum for tanning dyeing	2000	3	6000
Leather drying machine	5000	3	15000
Leather wet shaving machine	20000	3	60000
Leather splitting machine	68500	3	205500
Leather stuffing machine	20000	3	60000
Leather polish machine	20000	3	60000
Plate embossing and ironing machine	40000	3	120000
Leather finishing machine	12000	3	36000
Stainless steel color test drum for tanning machine	12000	3	36000
Double hook hanger for wet blue tannery	30000	3	90000
TOTAL			1122000

c) Vehicle cost: As the raw material is collected from all over Oman, the business needs at least one vehicle in each region. Therefore, the total trucks needed 8 trucks neglecting the big Lorries that will collect the raw materials from the main slaughterhouses. Assuming that each truck will costs 208,00 USD. Thus the total vehicles cost is: 208,00 USD * 8 trucks = 1664,00 USD

d) Consultant cost: Since the business is unique, a need of professional consultant is necessary to work as a guide and advisor in addition to providing the required support for installation of machines till the plant could stand by itself. The consultant is a German company called tanware. The expected amount is 65,000 USD.

5.1.2: Annual Running Cost:

a) Raw materials cost

The total raw materials cost of each type of animal hides is calculated based on Buser Central slaughterhouse selling prices:

Table 6 is showing the total raw materials cost for the industry.

Table 6: Raw materials cost

Animal type	Price(US \$)	Total hides	Total cost(US \$)
Sheep	11.7	116,675	1365097.5
Goats	5.2	270,226	1311575.2
Cows	11.7	114,348	1337871.6
Camels	2.6	23,866	62051.6

The total raw material cost = $1365097.5 + 1311575.2 + 1337871.6 + 62051.6 = 4170195.9$ USD.

b) Rented land cost

The plant will seize 15000 meter square. According to the Duqm Special Economic Zone Authority the medium industry which located in the central zone will cost (3.5 \$ per meter square per year). So the annual cost of the land = $15,000 * 3.5 = 52,500$ \$.

c) Labor cost: It includes Manufacturing workers, Drivers and their assistants, Administrative employees, Security guards. The total cost in this perspective is in 1301664 USD/year.

d) Water & electricity cost

The gallon of water costs 0.0078 USD according to The Public Authority for Electricity and Water. The water consumption is expected to reach 18000 gallons per day (medium tanning factory consumption rate).

Total cost = $18000 \text{ gallons} * 0.0078 \text{ USD} * 30 \text{ days} * 12 \text{ months} = 50544 \text{ USD/year}$.

The electricity consumption is expected to be 300MWh per month. The national utility tariffs for electricity costs 0.0312 USD/KWh for September to April and 0.0624 USD/KWh from May to August. Therefore, the total electricity costs will be:

$(300 \text{ MWh} * 1000 * 0.0312 \text{ USD/KWh} * 8 \text{ months}) + (300 \text{ MWh} * 1000 * 0.0624 \text{ USD/KWh} * 4 \text{ months}) = 1497,60 \text{ USD/year}$

The total water & electricity cost = 200,304 USD/year

e) Insurance cost

The insurance cost usually equals 5% from the insurance property. The property needs to be insurance are the buildings and the machines. The proposed cost will be:

$0.05 * (2704,000 + 1,122,000) = 191,300 \text{ USD}$.

f) Transportation cost

As the huge amount of hides coming from the slaughterhouses, there is a need to rent the big Lorries to translate the raw materials from Muscat, Sohar and Salalah to Duqm. The rent cost is about 3,900 USD/month. Then, the annual transportation cost will be: $3,900 \text{ USD/month} * 12 \text{ months} = 46,800 \text{ USD/year}$.

g) Maintenance Cost

The machine services, spare parts and regular maintenance are expected to cost 5,200 USD per month therefore the annual cost will be = $5,200 \text{ USD} * 12 \text{ months} = 62,400 \text{ USD/year}$.

h) Administrative & development cost

The other costs belong to government permits and residence renovations and other taxes are expected to cost 52,000 USD/year.

Furthermore, the cost of annual expansions in workers and machines is given a budget of 65,000 USD/year. Thus, the total Administrative & development cost will be $52,000 \text{ USD} + 65,000 \text{ USD} = 117,000 \text{ USD/year}$.

Table 7 is showing the summarized total cost.

Table 7: Capital investment and annual costs

	Type	Cost (USD)
Capital Investment	Building cost	2,704,000
	Machines cost	1,122,000
	Vehicles cost	166,400
	Consultant cost	65,000
		Total Capital Investment= 4,057,400 US \$
Annual Expenses	Raw materials cost	4,170,195.9
	Rented land cost	52,500
	Labor cost	1,301,664
	Water & electricity cost	200,304
	Insurance cost	191,300
	Transportation cost	46,800
	Maintenance Cost	62,400
	Administrative & development cost	117,000
		Total Annual Expenses= 6,142,163.9 US\$

5.2 Total revenue

The global price of finished cow leather vary from \$2.5 to \$5 per square feet while that of sheep leather varies from \$1.25 to \$2.75 per square feet. On the other hand, goat leather are sold at \$1.4 to \$2.8 per square feet and camel leather are sold at \$0.99 to \$1.99 per yard. Our calculation on revenue is based on the least market cost, which is as shown in Table 8.

Table 8: Total revenue

Leather type	Number of m ² per Unit	Total Unit (piece)	Price per square feet (\$)	Price per m ² (\$)	Total expected revenue (USD)
Cow	1.57	114348	2.5	26.9	4829259.084
Camel	1.78	23866	-	0.827	35132.18396
Sheep	0.55	116675	1.25	13.45	863,103.312
Goat	0.55	270226	1.4	15.064	2,238,876.456

From the table the total revenue of all leather types per year equals USD 7,966,371.036. As shown in Table 7 the project will require USD 4,057,400 as a capital cost to start up the business and USD 6,142,163.9 as annual costs to run the business. The base model of the business cash flow will assume that 30% of required funds

will be obtained from debt finance since the upper ceiling for investment loans in Oman does not exceed one million Omani rials while the other 70% of the required funds will be obtained from an external investor.

The debt finance will be used as a capital investment and the investor funds will be used as annual expenses for the first year in the form of monthly payments.

5.3 Payback period

The payback period is calculated assuming $i = 0.03$ & $n = 10$.

Table 9: Payback period for the proposed tannery industry.

Year	Cash Flow	Net Invested Cash
1	-4873866.4	-4873866.4
2	-3959778.16	-8833645.6
3	-33036.9	-8866681.2
4	+2215320.64	-6651361.6
5	+4672453.24	-1978906.8
6	+7353617.44	5374709.6
7	+10275073.64	15649784.8
8	+11111673.04	26761456.8
9	+31174267.8	38751559.6
10	+19073444.26	57825003.6

From the table 9 it has been seen that the net invested cash flow is negative up to year 5 and in year 6 it is positive. That means the payback period is located between year 5 and 6, which is short period compared to the amount invested.

6. Conclusions

This project attempted to identify and design an entrepreneur model for tannery industry in Oman, which gives a value added benefits for unused hides. Establishing such new idea and find the opportunity for tannery industry in the market will have a good impact to the community. In addition, the project will open new horizon for this local industry. It will help Omani government's quest to find an employment opportunities for Omani youths. Tannery industry has undeniable advantage for the country, where there are human labor force, sufficient water and abundant raw hides and skin. The industry will become one of the sectors significantly supporting economic development of the nation by generating foreign currency and employment opportunity for the citizens and locals. This project can offer a chance to open another related business industry in Oman like factories, which are using the treated leather to produce other products, which can be exported to outside Oman and consumed in local market.

As tradition, people disposal the animal hides by throwing it away which leads to harm the environment (Dettmer et al., 2010; Crudu et al., 2014). Therefore finding a way to recycle the leather will reduce the pollution and will have a good impact on the environment. However, tannery industry includes environmental issues associated with leather tanning and leather finishing with respect to wastewater, emission of pollutants in the air, solid waste and hazardous materials. Therefore, there is a need of additional study to overcome issues of hazardous waste that is a byproduct of tannery industry.

References

- Balkau, and F., and Scheijgrond, J.W., *Cleaner Production in Leather Tanning*. First edition. United Nations Publication pp. 65-76, 1996.
- Gangi, Y.A. and Timan, E., An empirical investigation of entrepreneurial environment in Sudan”. *World Journal of Entrepreneurship, Management and Sustainable Development* vol. 9, no. 2/3, pp. 168-177, 2013.
- Nazer, D.W., Al-Sa’ed, R.M., and Siebel, M.A., Reducing the environmental impact of the unhairing-liming process in the leather tanning industry, *Journal of Cleaner Production*, vol. 14, no. 1, pp. 65-74, 2006.
- Zhang, C., Lin, J., Jia, X., and Peng, B., A salt-free and chromium discharge minimizing tanning technology: the novel cleaner integrated chrome tanning process, *Journal of Cleaner Production*, vol. 112, part 1, pp. 1055-1063, 2016.
- Sumita, D., Ashish, Y., Premendra, D.D., and Mukul, D., Toxic hazards of leather industry and technologies to combat threat: a review, *Journal of Cleaner Production*, vol. 87, pp. 39-49, 2015.
- Crudu, M., Deselnicu, V., Deselnicu, D.C, and Albu, L., Valorization of titanium metal wastes as tanning agent used in leather industry, *Waste Management*, vol. 34, no. 10, pp. 1806-1814, 2014.
- Dettmer, A., Nunes, K.G.P., Gutterres, M., and Marcilio, N.R., Production of basic chromium sulphate by using recovered chromium from ashes of thermally treated leather, *Journal of Hazardous Materials*, vol. 176, no. 1-3, pp. 710-714, 2010.