# COMPOSTING OF TANNERY LIMED FLESHING

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## ABSTRACT

Leather processing involves the conversion of putrescible hide/skin into imputrescible leather. During leather processing, huge amounts of wastes e.g., solid, liquid and gaseous air pollutants are produced. Limed fleshing is one of the major proteinaceous solid waste which is produced in fleshing operation, tannery. The generated fleshing is usually kept indiscriminately inside or outside of the industrial area which causes environmental pollution. In this study, an investigation is carried out for composting the limed fleshing with other matrixes. In the composting period, samples were regularly collected for conducting different physicochemical tests. The final composts were tested for determining nitrogen (N), phosphorus (P), potassium (K) and sulfur (S) content. The obtained data were compared with the standard value. Results indicate that compost produce from the limed fleshing the nutrient NPK was within the standard level except for S. The compost could be used as agricultural purposes. The initiative could reduce pollution load generated through the tannery.

***Keywords:****Tannery, Limed fleshing, Composting, NPKS.*

## 1. INTRODUCTION

The global concern of environmental changes with industrialization and agricultural development have become an important issue (Abedin, Akter & Arafin, 2015). Bangladesh is a developing country. In Bangladesh, tannery plays a vital role regarding gross output, value addition, export earnings. Tanning converts putrescible raw hide/skin into imputrescible leather (Covington, 2016). Tanning is a complex procedure comprising of several technological steps; each and every step-in leather processing generates a significant amount of solid and liquid wastes as well as gaseous air pollutants. Due to environmental pollution, the Department of Environment (DoE), Bangladesh has been categorized the tannery as 'red' category industry.

In various stages of leather processing, tanneries generate a significant amount of solid wastes.In tannery at beam house fleshing is one of the most indispensable mechanical operations where substantial amounts of inevitable solid waste (fleshings) are produced.In leather making, based on the according to the data received from the studies of several researchers, approximately 200 kg of leather is manufactured from 1 ton of wet-salted skin/hide (Veeger, 1993) andmore than 600 kg is generated as solid wastes during the transformation of raw skin/hide into leather (Boopathy, Karthikeyan, Mandal & Sekaran, 2013). It is reported that fleshings are the 50-60% of total solid wastes generated in the tanning industry (Kanagaraj,Velappan, Babu & Sadulla, 2006). In Bangladesh, yearly 33.80 thousand tons wet salted cowhide and 24.80 thousand tons wet salted goatskin are taken for leather production in which $10.3\times10^3$ MT fleshings from the wet salted cowhide and $9.8\times10^3$ MT fleshings from the wet salted goatskin are generated during fleshing operation (Hashem, Nur-A-Tomal & Mondal, 2015).Fleshing contain alkaline pH (12.3±0.2), fat 4-18%, protein 5-7%, lime 2-6%, sulphide 2-4% (Lupo, 2006).

Tannery solid waste (fleshings) management has become a major environmental issue in Bangladesh. Till today, numerous works have been done to utilize the limed fleshings. Limed fleshings waste are widely used as a fat liquor in leather processing (Nasr, 2017). Extracted fat from cowhide limed fleshings in the tannery for soap production is a significant tannery solid waste management (Hashem & Nur-A-Tomal, 2015). Also, limed fleshing is used for the production of glue and gelatine to keep the environment clean (Kanagaraj,Velappan, Babu & Sadulla, 2006). Tannery limed fleshings has been utilized to produce compost using bacteria (Ravindran & Sekaran, 2010). Till now, composting is not so much popular for the utilization of limed fleshings. At the present time, composting is the better option of solid waste management especially organic solid waste than all other options. various microorganisms break down organic matter into the simpler nutrient-rich product, which is used as a soil conditioner. It is much better than chemical fertilizer because it is not associated with any kind of risk.

In this study, the preparation of compost using cow dung and limed fleshing with different ratio ensuring anaerobic condition. Anaerobic digestion constitutes one of the most efficient biological methods by which emissions of GHG, particularly ammonia and methane (Holm-Nielsen, Seadi & Oleskowicz–Popiel, 2009) can be reduced, with the additional benefit of energy recovery through the production of biogas, a renewable fuel composed mainly of methane (50-80% volume fraction) and carbon dioxide (Tambone,Scaglia, D'Imporzano, Schievano,Orzi & Salati 2010). This gas can also be used to produce electricity or heat, or as vehicle fuel (Holm-Nielsen, Seadi&Oleskowicz-Popiel, 2009). Composting depends on the pH, moisture content and temperature.

In the present day, an attempt was made to utilize the limed fleshings for making compost at cost-effective technique ensuring environment friendly solid waste management. The main aims of this study are (i) developing environmentally solid waste management by preparing to compost from limed fleshings which is used as organic compost for the agricultural field, (ii) To contribute to the environment by means of cleaner leather production.

## 2. METHODOLOGY

### 2.1 Sample Collection

Cowhide limed fleshing were collected from the tannery at Khulna, Bangladesh. Just after fleshing operation, limed fleshing was put in a polyethylene bag and brought back to the laboratory immediately for experimentation. Cow dung was collected from the house of a local habitant of Teligati, Fulbarigate, Khulna. For the germination test, Pepper seeds, Gourd seeds, coriander seeds were collected from Doulatpur bazar, Khulna.

### 2.2 Sample Preparation

After the collection of limed fleshings, it was chopped into very small pieces and mixed with cow dung in anaerobic condition with the different ratio which is shown in Table 1.


Figure 1: Sample preparation using limed fleshing and cowdung

Table1: Ratio of cow dung and fleshing

| ID | Composition | Ratio |
|---|---|---|
| CF11 | Cow dung: fleshing | 1:1 |
| CF21 | Cow dung: fleshing | 2:1 |
| CF31 | Cow dung: fleshing | 3:1 |
| CF41 | Cow dung: fleshing | 4:1 |

Then the above-stated composition was put into the polybags and kept underground for anaerobic degradation. The compositions were withdrawn from underground after16 days and kept for rest until the smell is removed. The CF11, CF21, CF31, and CF41 seems to the proper conditions for composting.

### 2.3 Reagents

0.2N sulphuric acid, 4% boric acid, 40% sodium hydroxide, molybdo-vanadate, 1N ammonium hydroxide, mono-calcium phosphorus, 25% nitric acid, acetic-phosphoric acid, barium sulphate, barium chloride and gum acacia-acetic solutions were used for determining different species in this study.

### 2.4 Determination of Moisture Content

The moisture content of the samples was determined by the oven-dried laboratory method. A container was cleaned with lid dry it and weigh it. Then a sample was taken into the container and weighed with lid and the sample was dried to constant weight maintaining the temperature between 105°C to 110°C for a period varying with the type of sample but usually 16 to 24 hours. Finally, the constant weight was recorded for the container with the dried sample.

### 2.4.1Reconciliation of Moisture Content

#### *2.4.1.1 Conditioning of CF11*

Maintaining standard moisture content for compost the whole amount of CF11 sample i.e.167 g of CF11 e.g. the mixture of dried cow dung and fleshing were taken. 64 g water in the mixture of the sample was added for ensuring required moisture content. Then the sample and the water were mixed well.

#### *2.4.1.2 Conditioning of CF21*

Maintaining standard moisture content for compost the whole amount of CF21 sample i.e.167 g of CF21 e.g. the mixture of dried cow dung and fleshing were taken. 64 g water in the mixture of the sample was added for ensuring required moisture content. Then the sample and the water were mixed well.

#### *2.4.1.3 Conditioning of CF31*

Maintaining standard moisture content for compost the whole amount of CF31 sample i.e.170 g of CF31 e.g. the mixture of dried cow dung and fleshing were taken. 60 g water in the mixture of the sample was added for ensuring required moisture content. Then the sample and the water were mixed well.

#### *2.4.1.4 Conditioning of CF41*

Maintaining standard moisture content for compost the whole amount of CF41 sample i.e.140 g of CF41 e.g. the mixture of dried cow dung and fleshing were taken. 55 g water in the mixture of the sample was added for ensuring required moisture content. Then the sample and the water were mixed well.

### 2.5 Determination of pH

The pH of the conditioned samples (a mixture of fleshings and cow dung) was measured by using the pH (UPH-314, UNILAB, USA) meter. Before measuring the pH, the meter was calibrated with the standard buffer solution.

### 2.6 Determination of Nitrogen Content

Total Nitrogen content of the compost sample was estimated by the micro-Kjeldahl method as per the procedure suggested by AOAC (1995). The compost sample was digested by adding sulphuric acid in the presence of a catalyst at the temperature between 360-410°C. Then, the digested sample was heated by passing steam at a steady rate and the liberated ammonia absorbed of 4% boric acid containing mixed indicator solution kept in aconical flask with the absorption of ammonia, the pinkish colour was turned to green. Finally, the green colour distillate was titrating with 0.02N sulphuric acid and the colour changed to original shade (pinkish colour).

### 2.7 Determination of Phosphorus Content

Phosphorus content of the compost sample was estimated by spectrophotometric molybdo–vanadate method. For ensuring the standard value of phosphorus content, it is important to determine the P content of the compost. The compost sample solutions were mixed with molybdo–vanadate reagent was added makes up the volume with transmittance/absorbance was read at 420 mμ (blue filter). Finally,ammonium molybdate vanadate solution was added and then shaken the content and turned into the yellow colour complex.

### 2.8 Determination of PotassiumContent

The potassium content of the compost sample was determined by extracting the soil with neutral normal ammonium acetate solution. The compost sample solutions were taken in a different volumetric flask and 5g of the sample was added to the flasks with 25 mL 1N ammonium hydroxide.

Then the solution was shaken for 5 minutes and then filtered through Whatman No.1 filter paper. Now, the potassium extract was measured by flame photometer after calibration.

### 2.9 Determination of SulphurContent

Sulphur is estimated by the turbidimetric method. For ensuring the standard value of S content, it is important to determine the S content of the compost. The compost sample was mixed with monocalcium phosphorus ensuring shaken for one hour and filtrated through the Whatman No. 1 filter paper. After filtration, the filtrate mixed with nitric acid, acetic phosphorus acid and barium sulphate ensuring the precipitation of barium chloride. Then gum acacia–acetic acid solution was added and measured the colour intensity at 440 nm (blue filter).

### 2.10 Germination Test

Germination is the process by which an organism grows from a seed or similar structure. The most common example of germination is the sprouting of a seedling from a seed of an angiosperm or gymnosperm.The visual test of the compost was carried out by sowing seeds in compost with the soil. The soil was mixed with all the samples of compost in different ratiose.g., CF11: Soil (1:1), CF11: Soil (1:2) and CF11 (1:3) in the crocks same as for others.Approximately 5-6 pieces of pepper seeds and two pieces of gourd seeds were added in the composts which were placed 2-3 cm below from the surface with ensuring sprinkling water on the mixtures for keeping observation of germination.

## 3. RESULTS AND DISCUSSION

### 3.1 NPKS in Compost

In Figure2 depict the nutrient content of the final compost. The maximum N content (3.1%) was found in the CF31 and N content (2.1%) found in CF21 isminimum comparing other samples i.e. CF11 and CF41 whose have N content 2.3% and 2.4%, respectively. Inorganic phosphorus (P) was another important nutrient in compost which is presented in a maximum amount (2.5%) in CF41 and found minimum content (2.0%) in CF11. Also, P content in CF21 and CF31 are 2.2% and 2.4% which is gradually increased with the amount of cow dung.

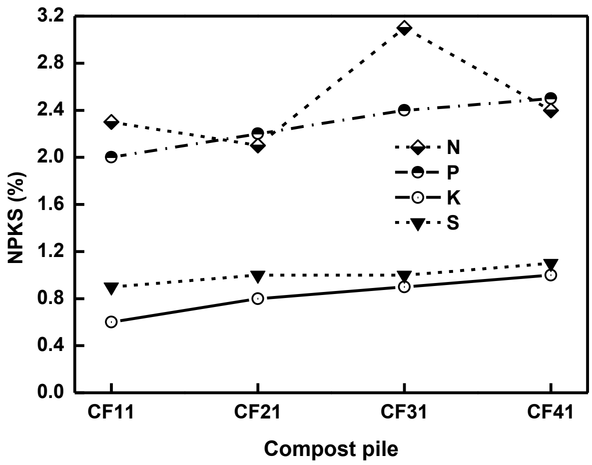


Figure 2: NPKS content of the compost

Also, Figure 2 also shows the Potassium (K) content in compost in percentage (%). The maximum K content (1.0%) present in CF41 and minimum content (0.6%) of K show in the CF11. Also, K content in other samples of compost i.e. CF21 have 0.8% and CF31 have 0.9%. Sulphur (S) is a significant nutrient for plant growth. The dotted line with triangle represents the S content in the compost. Among the different types of sample composition, the maximum S content (1.1%) was found in the CF41 and the compost sample named CF21 and CF31 both have same S content (1.0%) which is minimum.

### 3.2 Nutrient comparison with standard

Table 2 shows the nutrient content of the final compost. In CF11 (CD: LF=1:1), the nutrient N, P, K and S content were 2.3%, 2.0%, 0.6% and 0.9%, respectively. The three nutrients for the all ratio of CD: LF (Cow dung: limed fleshing) i.e. NPK meet the standard value (N= 0.5-4.0%; P= 0.5-3.0% and K= 0.5-3.0%) as declared by the Bangladesh Government. Although the S value was higher than the standard value (S=0.1-0.5%). It may be the reason is that limed fleshing content higher amount of sulphide. The pH for the CF11, CF21 and CF31 was 7.6, 8.4 and 8.5, respectively. Only the pH of CF41 (8.8) was at the closed margin.

Table2: Tested results of NPKS for the final compost

| **Parameters** | **CD: LF (**1: 1) | **CD**:**LF(**2: 1) | **CD**:**LF (**3: 1) | **CD**:**LF(**4: 1) | **Standard** | **Unit** |
|---|---|---|---|---|---|---|
| pH | 7.6 | 8.4 | 8.5 | 8.8 | 6.0-8.5 | - |
| N | 2.3 | 2.1 | 3.1 | 2.4 | 0.5-4.0 | % |
| P | 2.0 | 2.2 | 2.4 | 2.5 | 0.5-2.0 | % |
| K | 0.6 | 0.8 | 0.9 | 1.0 | 0.5-3.0 | % |
| S | 0.9 | 1.0 | 1.0 | 1.1 | 0.1-0.5 | % |

The nutrient (NPKS) in CF21, NPK hasthe ability to meet the standard value as the value 2.1%, 2.2% and 0.8%, respectively. But the S content (1.0%) is almost doubled than the maximum standard value (0.1-0.5%) and it is happened not only for CF21 but also for other compost sample i.e. CF31 which have S content is 1.0% and CF41 which have 1.1% S content.However, the NPK content of CF31 (N= 3.1%, P=2.4% and K=0.9%) and CF41 (N=2.4%, P=2.5% and K=1.0%) both of composts satisfy the Bangladesh standard for compost. Among four compost the maximum N content was in CF31 i.e. 3.1%. The higher amount of PKS content was in CF41. It seems that the higher amount of limed fleshing the higher thepH.As the digestion process was done by the anaerobic condition the S content remains in the compost is higher than standard which is seen in the above table. If the composting process would be carried out by aerobic digestion then the S content might be reduced which is the possible solution for high S content problem in compost and to meet the standard value.

### 3.3 Moisture content of final compost

As the composting process was conducted under anaerobic condition, after mixing all ingredients the moisture content was maintained between 45-55% with sprinkling water. Huge (1993) reported that in composting, moisture content should be maintainedbetween 40-60%. The composting was conducted 35 days and every 7 days the moisture was monitored. The moisture content of the final compost is depicted in Table 3.

Table 3: Moisture content of the compost

| **Sample ID** | **Moisture content (%)** |
|---|---|
| CF11 (CD: LF=1:1) | 40.03 |
| CF21 (CD: LF=2:1) | 41.02 |
| CF31 (CD: LF=3:1) | 42.07 |
| CF41 (CD: LF=4:1) | 41.90 |

It is clear from Table 3 that the moisture content of CF31 was 42.02% which indicatethe satisfactory level of moisture content was during compostingcompared thansamples.The lowest moisture content i.e.40.03% was in the sample of CF11. The moisture content in the sample CF21 and CF 41 was 41.02% and 41.90%, respectively. It is obvious that during composting, in all samples the moisture content was enough for composting to meet the optimum moisture content for satisfactory microbial activity.

### 3.4 Germination of pepper and gourd seeds

The suitability test of compost for agricultural purposes was carried out by germination of pepper seeds and gourd seeds. Among the compost samples, CF31 (CF:Soil=1:2) and CF41 (CF: Soil=1:3)have better germination as the significant growth of pepper plantwhich is shown in the Figure 3 as the NPKS content of those samples are comparatively higher than other samples i.e. CF11 (N=2.3%, P=2.0%, K=0.6% and S=0.9%) and CF21 (N=2.1%, P=2.2%, K=0.8% and S=1.0%). After 2 weeks of observation, the sample CF31: Soil=1:2 has better plant height but was not so much nourished.

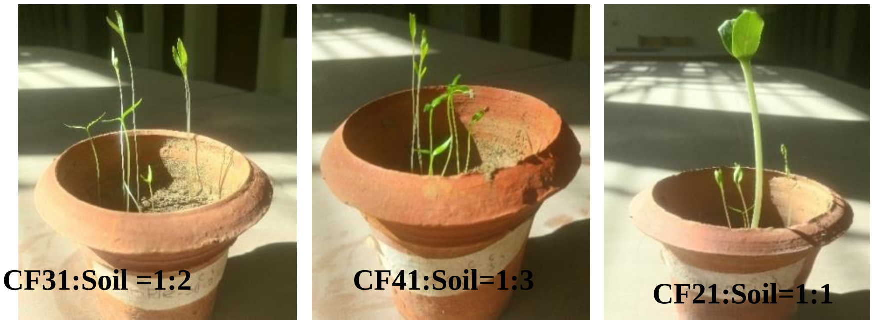


Figure 3: Germination test by sowing pepper seeds and gourd seeds

In contrast, CF41: Soil=1:3 was the most nourished with less plant height of pepper plants. Moreover, the sample CF21 (CF21: Soil=1:1) represents the better germination results in terms of the growth of gourd plants which is also shown in Fig.3. The indiscrimination in the growth of the plants in terms of plant height and nourishment due to the variation in the amount of soil and uneven nutrient i.e. some of the nutrients contribute to plant height and some other contribute to plant nourishment.

## 4. CONCLUSIONS

Fleshing has a negative effect on the environment. This study is an approach of preparing compost from limed fleshing which could be a solution to manage the solid waste in the tannery. Compost is used as a very effective natural fertilizer without environmental disturbance. hazards. Compostprepared from their respective organic wastes possessed considerably higher levels of major nutrients-NPK except S. The composting process could be optimized in reducingSulphur content at the standard level.

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