

## **Bio pretanning**

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### **BIO PRETANNING**

#### **ABSTRACT:**

We know that the leather is an age old industry. The process followed in the industry is being followed for more than 50 years. Though some new innovations are being introduced we are not in the track of replacing the process of Pretanning (saying that leather is made in lime yard) since it is more essential for the quality of the leather produced. Nowadays people speak about the use of enzyme in the industry. Also the present processing techniques leads to pollution which forms a great drawback to the industry. This paper aims in change of the Pretanning operations followed in the industry. As we say cut the diamond with the diamond, the main reason of tanning the leather with tanning agents is that to preserve the degradable skin(due to bacteria) into nondegradable leather, the paper aims at usage of the bacteria for Pretanning operation as well as extending to the tanning operation. By this mode the processing cost and the pollution problems may drastically be reduced. The bacteria which is going to be used up for this process is created as indicated in the paper for fine pretanning.

## Introduction

The leather industry is a by-product industry of meat industry. The waste material (skin) is converted into a useful product by leather processing. If the skin is not converted into useful product like leather then there will be an adverse effect on the environment. Though the cyclic chain is broken it is converted into a useful product. The main disadvantage as well as the requirement of the leather processing are the do and undo methods. For example the leather is salted (protection) and desalted thus the time as well as the cost of the production of leather goes high including the environment pollution.

This paper shows the way of removing the unwanted material of the skin and using the required collagen directly for tanning. If we see the tanner aims at preparing the skin to be tanned by removing the unwanted materials like hair(except fur tanning), flesh, some soluble proteins in pretanning. Thus the tanner removes the biological matter with the help of chemicals. One can experience that a dead animal (dog) on the road is decayed and completely destroyed within 2 days. Thus the nature contains micro organisms and scavengers for completely destroying the body of the animal. This is possible only if the micro organisms contain sufficient enzymes for complete degradation of the body. This is why the skin which is flayed of is protected since it may be degraded by the microorganisms. If this is possible then control degradation of waste material is possible. So the controlled degradation can be done. This is explained below and now let us see the actual manufacture and how it can be replaced.

Present mode of leather manufacture:



The principal of leather making protein, collagen, exists in hides and skins in association with various globular proteins, viz. albumin, globulin, mucoids; and fibrous proteins such as elastin, keratin, and reticulin. During leather manufacture, the noncollagenous constituents are removed partially or completely in the various pre-tanning operations; the extent of removal of these constituents decides the characteristics of the final leather.

Besides chemical treatment, certain enzymatic treatments are also necessary to get optimum results. The raw hide has to undergo a series of chemical treatments before it turns into flattering leather. This includes soaking, liming, dehairing, deliming, bating, degreasing, and pickling. For all these steps, the chemicals used are quite toxic. The steps are as follows

### **Preservation:**

The skin or hide is first cured by different means to preserve the skin from bacterial degradation.

### **Soaking:**

In pre-tanning operations, the hides and skins are first subjected to a water soak to remove the salt if used to preserve. This is to bring the matrix to original condition

### **Liming:**

Dehairing is used to be followed by opening up of fibre structure in 'liming'. The dehaired hide is transferred to an alkaline solution of lime milk where swelling occurs and the nonfibrillar proteins are dissolved. After mechanical removal of the subcutaneous tissue, thus the material are transferred and need of equipments to dehair and fleshing is carried out in machine

### **Deliming:**

Deliming is performed in order to remove the adsorbed lime from the hide and to eliminate the lime swell.

### **Bating:**

One such treatment, bating, is the only step in leather processing where enzymatic process cannot be substituted by chemical processes. The process of bating gives certain desired characteristics to the finished leather. Earlier, the process was carried out using dog dung or manure. The use of this was not only unhygienic but fermentation could also not be controlled. Now the use of alkaline bate is used.

### **Degreasing:**

The fat present in the hide skins is removed either as soluble lime soap or hydrolysis products like fatty acids. Kerosene, chlorinated hydrocarbons, and white spirit are used in

the degreasing system which adds to the toxicity of the environment and effluents, mostly used for high fat containing skin like sheep skin.

**Pickling:**

The pelt is to be given acid treatment if it is to be tanned with organic (partial) or inorganic tannages.

**Effects of pretanning:**

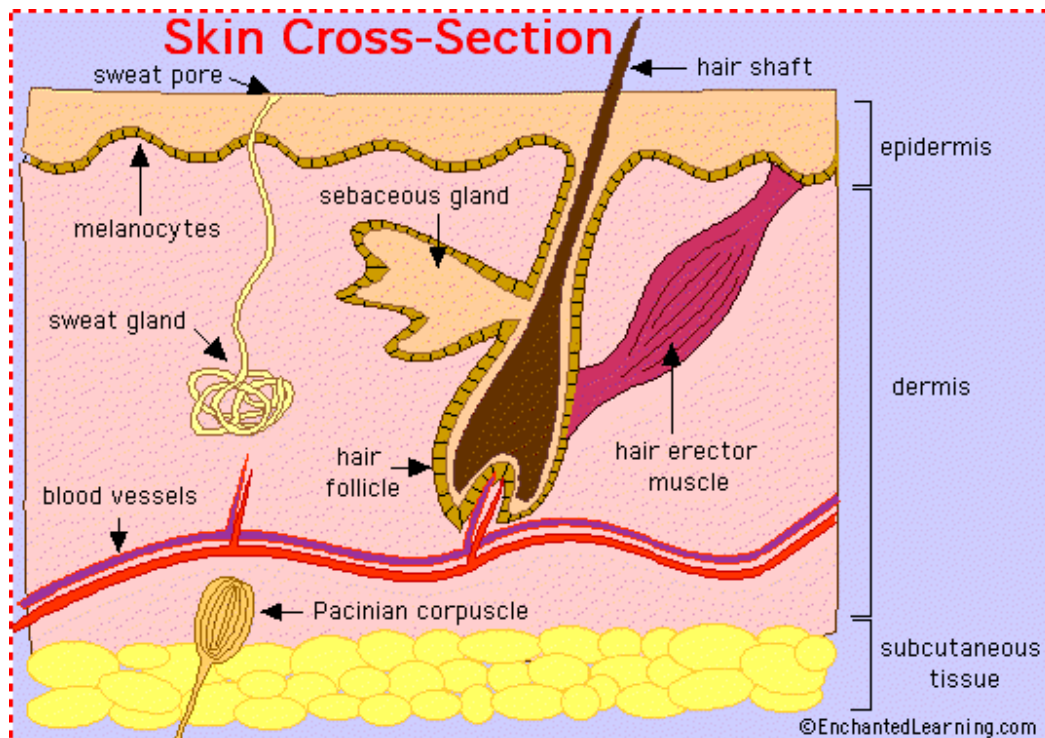
Due to these pretanning operations, the leather processing industry is one of the worst offenders of the environment. Leather industry contributes to one of the major industrial pollution problems facing the country, and the pollution causing chemicals, viz. lime, sodium sulphide, salt, solvents, etc. arise mainly from the pre-tanning processes of leather processing. Along with this the salt from curing also adds to the TDS of the effluent. Environmental pollution has been a major irritant to industrial development. Chemical and chemical-based industries are the prime targets of the environmentalists for their crusade against pollution, and leather industry has also not been left out of the reckoning.

The generation of pollution is significantly high in the pre-tanning operations compared to the post-tanning operations. The chemicals mainly responsible for pollution in pre-tanning processes are lime, sodium sulphide, and caustic soda apart from common salt and degreasing chemicals. In fact, one third of the pollution caused by the leather industries results from the wastes generated during dehairing operations. The wastes from the tanneries are let out into the drains which in turn empty into the main sewerage causing hazard to those who use this water. Many tanneries have been forced to close down because of their noncompliance with the standards laid down. Thus the problem is a serious issue and the alternatives have arrived at the market like enzymatic pretanning which is proving to be good. But a major disadvantage of the enzymatic pretanning is the cost of the enzyme which is of course not suitable for the tanners to shift into the system. So a simple but useful process sequence should be adopted so that it is taken up by the industry.

**Presumptive measures for changing the view on Pretanning:**

Thus the above process is continued and the effects are seen very easily. So a change in the process is recommended. One can see the enzymes that are manufactured from the micro organisms are proved to be good pretanners. Then definitely the microorganism having these enzymes can act as the pretanners. For this a clear understanding of the pretanning is required. Thus we go on for a complete analysis of the skin.

Biological nature of skin:



#### Contents of skin:

Our major requirement in a skin which is discussed below.

**Dermis** - (also called the cutis) the layer of the skin just beneath the epidermis. This is the layer contains the required collagen material along with some needless substance that are removed on the following steps.

**Epidermis** - the outer layer of the skin.

**Sebaceous gland** - a small, sack-shaped gland that releases oily (fatty) liquids onto the hair follicle (the oil lubricated and softens the skin). These glands are located in the dermis, usually next to hair follicles.

**Sweat gland** - (also called sudoriferous gland) a tube-shaped gland that produces perspiration (sweat). The gland is located in the epidermis; it releases sweat onto the skin.

**Subcutaneous tissue** - fatty tissue located under the dermis

Thus the skin contains of fibrous and non fibrous materials in which, the need material collagen is safe guarded and the useless parts are removed. So it is clear that the materials that are required and not required can be separated and then the microorganism is designed according to it.

Major parts of skin:

Useful material:

1) Collagen

Useless material:

- 1) NonFibrous
- 2) Fibrous material other than collagen(reticulin, elastin,keratin)
- 3) Fatty tissues

The skin that is tanned and the material that are removed are nothing but proteins and lipids. The above all material are biological components can be degraded with the bacteria containing specific enzymes. The bacteria used for the above '**bacrsk**' is selected. The bacterium is modified according to the needs of the leather pretanning. Thus one can make sure that the bacterium is specially designed for the purpose of pretanning.

### Designing of the bacteria

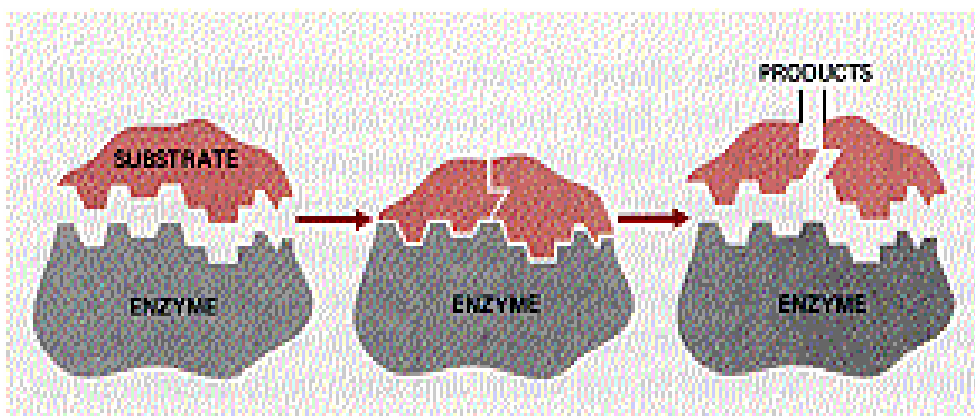
#### Technologies:

The microorganism that is created are on basis of the following concepts.

#### Specificity of Enzymes

One of the properties of enzymes that makes them as important as diagnostic and research tools is the specificity they exhibit relative to the reactions they catalyze. A few enzymes exhibit absolute specificity; that is, they will catalyze only one particular reaction. Other enzymes will be specific for a particular type of chemical bond or functional group. There are four distinct types of specificity:

- Absolute specificity - the enzyme will catalyze only one reaction.
- Group specificity - the enzyme will act only on molecules that have specific functional groups, such as amino, phosphate and methyl groups.
- Linkage specificity - the enzyme will act on a particular type of chemical bond regardless of the rest of the molecular structure.



Thus from the above biotechnological law it is possible for a bacteria to degrade proteins only if it contains the specific enzymes. Thus the living of bacteria is that it degrades the complex substance and consumes the food as simpler molecules. So the bacteria designed contain all the need enzyme required for the degradation of the useless material of skin and should not contain the enzyme that may degrade the collagen (collagenase). So for a fine pretanning the bacteria should secrete enzymes for the consumption of the food (useless material) and keep the rest untouched (collagen).

The bacteria should be able to secrete

- 1) protease (except collagenase)
- 2) lipases

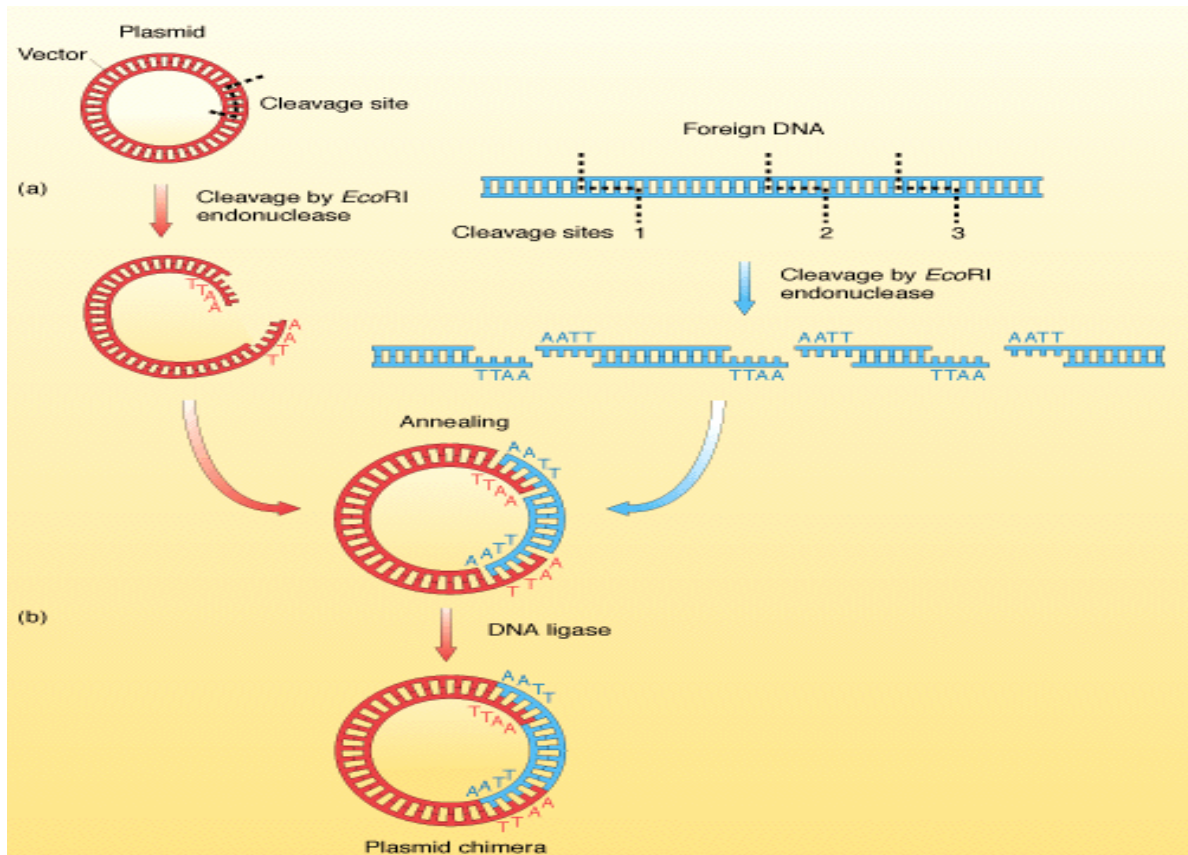
This is possible because the enzymes are manufactured in fermenters by providing substrates to the bacterium medium. Similarly here the bacteria is given a substrate of leather itself on which it feeds by secreting the enzymes that degrades the useless materials.

Thus the above bacteria can be designed with the powerful tool of biotechnology described below

Initiatives:

- 1) the bacteria that is able to degrade the non fibrous proteins, hair and fats is identified(found already)
- 2) The bacteria should be free of the genetic code for secreting the collagenase enzyme.
- 3) Then the amylase(fibre separation) secreting gene is introduced into the bacteria as above
- 4) Moreover the bacteria should not have harmful effects on working.(**bacrsk** is non pathogen)
- 5) The bacteria should also protect the leather from other microorganism by working in an adverse pH conditions.

The 2 and 3 are done as follows



## Recombinant DNA technology

1. Recombinant technology begins with the isolation of a gene of interest (amylase). The gene is then inserted into a vector and cloned. A vector is a piece of DNA that is capable of independent growth; commonly used vectors are bacterial plasmids and viral phages. The gene of interest (foreign DNA) is integrated into the plasmid or phage, and this is referred to as recombinant DNA.
2. Before introducing the vector containing the foreign DNA into host cells to express the protein, it must be cloned. Cloning is necessary to produce numerous copies of the DNA since the initial supply is inadequate to insert into host cells.
3. The bacsk used is first mutated (removal of gene for production of collagenase) before the vector is introduced. This can be done by removing the particular gene for the production of the enzyme.
4. Above all the modification that is need for future can be made by making this bacterium as reference.



The vector is isolated in large quantities and introduced into the desired host cells (**bacrsk**). The host cells will then synthesize the protein (amylase) from the recombinant DNA. The cells are grown in vast quantities, and tested for the effects on the leather.

**Comments:** Thus the bacteria can created by following the above methods definitely. Here the steps 2,3,5 is alone to be made.

Degradation of the bacteria:

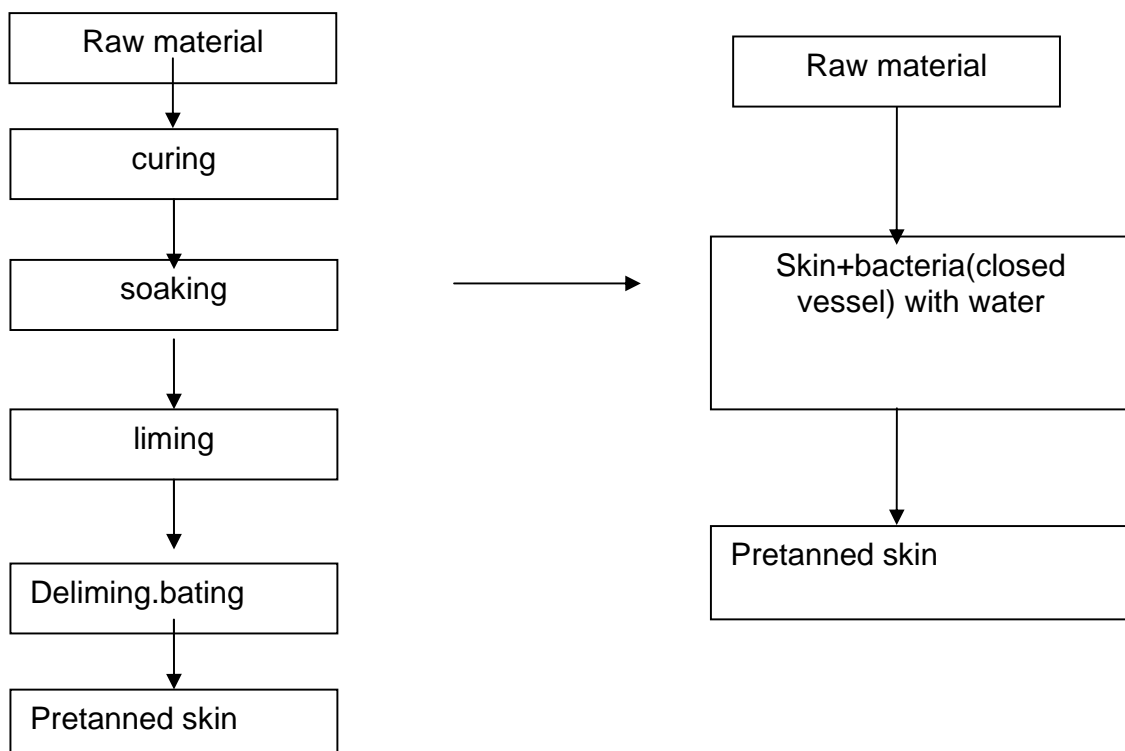
Proteases  
 Proteins ——— ~~peptones~~ (food for the bacteria)

lipase  
 Lipids ——— ~~triglycerides~~ and smaller units

The enzyme amylase is made to secrete in order to digest proteoglycans used for fine fibre separation.

The above products are separated and the pelt is washed for removal of these products.

The bacteria created can convert the leather pretanning as follows



The skin along with the bacteria is given an acid wash to pickle the leather as well as the excess bacteria are destroyed.

**Advantages:**

By using the above change in the process we can have the following advantages

- 1) No chemical processing so no chemicals used finally any environment pollution will not be observed.
- 2) Since the process takes place in a single step the time required for a preparation of pretanned leather is much less than any process followed now.
- 3) Since it is a natural process there is no adverse effects
- 4) Since there is no use of the chemical, machinery requirement the cost of manufacture drastically reduces.
- 5) The bacteria for the next sequence process can be easily obtained from the previous liquors.
- 6) Since the bacteria is non pathogen no effects can be observed to the workers
- 7) Also due to the closed system there is no problem of smelling
- 8) A small amount of biomass is enough since the growth of the bacteria is exponential in favorable conditions.

**Disadvantages:**

- 1) The bacteria for the final usage are not found till now. If supported by leading biotech labs it can be made.
- 2) The by products to be carefully watched.

**Conclusion:**

Though the project might seem to be a dream, this would definitely come true in the following years. The bacteria used can be used for any type of skin because though histological characters are changed the skin is made of proteins only. Thus the bacterial pretanning can have a revolution in the leather industry.