

Review Article

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## Overview of Textile and Leather Industries Waste Treatment Processes

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### ABSTRACT

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Waste control has gone through alterations in most recent numerous years, and as of now reusing and recuperation are an extra imperative consideration the waste from industries is a significant thought, not just due to the amount created anyway likewise because of its capacity detrimental effect on ecological and human wellbeing. Fused waste administration might be a structure for planning and forcing new waste-administration frameworks and for examining and upgrading present frameworks. Inside this structure, every specialized and nontechnical added substances of the administration gadget should be investigated together. Here we are worried about textile and tanneries squander sway and the amount and nature of the poisons released. Talking quickly a gigantic measure of profluent produced from tanning and material businesses is being released ashore or into water sources. These effluents are described by physical, synthetic or organic attributes, example, BOD COD. These effluents additionally contains certain optional plant supplements, example, nitrogen, phosphorous, sulfur, magnesium, calcium and so forth just as micronutrients and hefty metals. Expansion of tannery waste and material waste causes deflocculation of soil particles, increment in nitrogen, phosphorous level accordingly causing antagonistic impact on the yields bushes trees just as water bodies. It has been noted salinization and alkalization of groundwater have been taken note. Actual attributes of these don't allow its removal straightforwardly into inland water or ashore for satisfaction of horticultural practices. Henceforth, Today a current day coordinated waste control that imbues maintainability into all added substances while considering help convey and call for is required.

### Introduction

The ascent of worldwide principles has arisen as a dubious new subject matter within the literature on alternate and consequently the surroundings in recent years. This paper makes an empirical contribution to the rising literature on global standards and export competitiveness by analyzing how an exertions-in depth developing-us of an

enterprise (Indian leather items and textile and apparel) complied with an advanced-global environmental fashionable that affected exchange and marketplace access. In response to many interrelated components, which incorporates better expenses of garbage removal, more prominent severe authoritative prerequisites, and developing natural center, enterprises are continually actualizing more noteworthy supportable procedures to

decrease subjective and quantitative business contamination masses and to reuse water and waste. Creation and handling businesses burn-through great estimated amounts of energy and water, and delivers enormous limits of wastewater.

Indian assembling industry has seen fast improvement after the usage of the new business strategy of 1991. The change assignments of the approach have prompted enhancements in TFP for a portion of the enterprises. During the primer yrs. of industrialization, specialists has offered priority to little scope ventures which make a commitment eminently to net home product, business innovation and fare. Notwithstanding, numerous investigations also featured the awful issue of little scope businesses like wasteful utilization of help, negative natural consistence and sub-boundless working circumstances which has direct concerning efficiency execution of an organization. While for a larger than average organization, it is less convoluted to misused economies of scale to improve its efficiency. It have discovered variant in TE across states which is presumably credited to qualification in infrastructural improvement like get passage to power, delivery and verbal trade offices.

Business use of those assets is additionally answerable for the disposal of an enormous extent of effluents, ensuing in issues about the treatment and disposal of effluents and effect associated with discharges to the surroundings and water first-class.

The primary parts to be contemplated in wastewater treatment are covered inside the accompanying classes:

Adjourned Solids,  
Organic effluence (Biodegradable),  
Infectious Microbes or agents (Pathogens),  
Food Source for Microbes (Nutrients),

Priority (“Toxic” as defined in Clean Water Act, USA) pollutants,  
Refractory natural pollutants,  
Heavy Metals (such as Mercury, Arsenic, Lead, Chromium etc.) also  
Dissolved Inert Entities.

Bodily stuffs, chemical and organic traits of wastewaters are interconnected, e.g. bodily and chemical characteristics of water our bodies have an effect on the abundance, species composition, balance, productiveness and organic situations of populations of aquatic organisms. Concerning physical residences, as an example, temperature can also have an effect on the gases, and, in some cases, the dissolved inorganic solids. Any other belongings, turbidity is associated with suspended strong concentrations.

The pollution potential of wastewater is at once proportional to the pollutants concentration. The wastewater characterization allows establishment of the required remedy machine to make sure the standard of handled wastewater effluent.

### **Literature review and process**

In this paper, I have considered two industries namely being my topic of interest:

Textile Industry  
Tanneries

### **Textile industry**

Textile Industry is one among the most important and oldest industries present globally. The industry provides jobs with no required special skills, which in turn plays a major role in providing employment in poor countries like Bangladesh, Vietnam, Sri Lanka and Mauritius. Therefore, it plays a dynamic role in the increase of GDP value of these countries.

Textile industry is classified into 3 main categories:

Cellulose (which include cotton, rayon, linen, ramie, hemp and lyocell),

Protein (which includes wool, angora, mohair, cashmere and silk) and

Synthetic (includes polyester, nylon, spandex, acetate, acrylic, ingeo and polypropylene).

Colors and Chemicals utilized in the textile industries depends on manufactured fabrics. Reactive colors (remazol, Cibron F and procion MX), naphthol colors (fast yellow GC, fast scarlet R and fast blue B), direct colors (direct yellow 50, Congo red and direct brown 116), and indigo colors (indigo white and indigo carmine) are some of the colors used to color cellulose fibers. Protein fibers are colored using acid colors (triarylmethane colors, azo colors and Anthraquinone colors) and Lanaset colors (Bordeaux B, Blue 5G). Other colors, like dispersed colors (Disperse yellow 218 and disperse navy 35), basic colors (basic orange 37 and basic red 1) and direct colors, are used to color synthetic fibers. Reactive colors are the foremost commonly used cellulose fiber color. Cotton, one of the most widely used fibers is colored mainly using reactive colors. The world use of reactive colors increased from 60,000 tons in 1988 to 178,000 tons in 2004. Cotton could also be colored using direct colors, indigo colors and naphthol colors.

High pH is found to denature proteins consequently corrosive colors are generally utilized protein strands. Compound responses between corrosive color and filaments are found to shape an insoluble color particle on the fiber. Lanaset colors are one of famous gathering of colors characterized under receptive and corrosive colors that color protein filaments. Usually Reactive colors are utilized to color protein filaments. Fleece,

mohair, angora, cashmere and silk could be colored utilizing corrosive or responsive colors.

Most generally utilized manufactured textures color to color polyester, nylon or acetic acid derivations are Dispersed colors. Nylon strands are discovered to be viable when colored with direct colors. Essential colors are discovered to be a solid shading operator when utilized on acrylic fibers. Industries of Textile produce a lot of fluid squanders that contain natural and inorganic mixes. A few essential, optional and tertiary treatment measures have been utilized to treat these effluents. These included flocculation, synthetic coagulation, basic sedimentation, circulated air through tidal ponds, oxygen consuming initiated muck, streaming channels, invert assimilation and electro dialysis.

In any case, these aren't powerful against the expulsion, all things considered, and synthetic compounds utilized. These effluents contain high concentration of colors, yet in addition synthetics used at differed preparing stages. Some follow metals like Cr, Cu, As, and Zinc are available in these gushing are equipped for causing a few medical conditions including nausea, hemorrhage, serious skin related issues.

Progressed oxidation measures (AOPs) created to get hydroxyl free extremists utilizing various oxidants under various blends. These radicals devastate parts that are not obliterated under regular oxidation measures. AOP utilizing ozone, photo phenton, TiO<sub>2</sub>, Ultraviolet, Fenton and peroxide are frequently wont to treat textile colors. The principle advantage of the treatment method is:

it's nature is of destructive type,

Mineralization of the contaminants of organic type those are present in wastewater.

AOPs are considered as low or non-squander age advancements that wrecks complex structures utilizing fleeting compound species with a high oxidation power.

### **Types of textiles and textile industries**

Various manufacturing processes are administered for various sorts of textiles. The process of production of textiles is broadly classified in two categories:

Spinning or the dry process

Wet process which involves usage of colors.

Creation of cotton textile includes the division of cotton strands from the cotton seeds which are then spun into cotton yarns. These yarns are meshed effectively into textile. The textile at that point go through different wet cycles including burning and scouring, hence utilizing huge measure of water.

Coloring is one among the preminent significant strides inside the wet cycle which includes changing the shade of the material spun utilizing colors. Completing is that the last advance in assembling and uses synthetic compounds likes HS-ULTRAPHIL, ECODESIZE-PS-10 and Amino silicone liquid to treat the fabrics for acquiring an obviously better quality.

The initial phase in the creation of livestockshide items includes the expulsion of hair, between fibrillary protein and epidermis utilizing physical and mechanical strategies. The livestockshide is first treated with stomach related chemicals to eliminate the non-sinewy proteins and afterward absorbed sulphuric corrosive to bring down the pH. At that point, it goes through tanning utilizing different kinds of tanning measure:

mineral/chrome tanning, vegetable tanning and oil tanning. At last, the calfskin goes through coloring and completing cycles.

The creation of silks includes the extraction of silk strings from the cases. The strings have a glutinous substance which is taken out by washing and dying. The strings are then weaved and go through the withering cycle which gives the silks an alternate shade. After the coloring cycle, the strings go through the completing cycle.

**Colors used in the textile manufacturing process:** Different sorts of textile are colored utilizing various kinds of colors. Colors can be ordered into various kinds relying upon their substance organizations and properties. Accordingly, the utilization of colors differs from industry to industry contingent upon textures they produce.

**Colors for cellulose fibers:** Cellulose is comprised of rehashing glucose units. The most generally utilized color for cellulose textile is receptive colors. Different sorts of colors utilized are immediate colors, tank colors, Sulfur colors, indigo colors and naphthol colors.

**Reactive colors:** otherwise called fiber receptive colors are most significant coloring class for cellulosic filaments, used to color protein strands, for example, fleece and silk equipped for shaping covalent bonds with the fiber atom and viewed as best and lasting colors utilized. Found to figure well on any cellulose fiber under various temperatures. Receptive colors are of two sorts: homo bi functional and hetero bi functional.

**Procion MX:** is a cold water reactive color that could be utilized at ordinary room temperature. These fiber responsive colors are found to deliver shading inside fiber instead of on its surface, thus have light speed and

wash speed. They are discovered to be brilliant for direct applications, printing, splash painting and submersions coloring techniques. Nonetheless, most usually utilized in tie coloring.

**Cibron F:** another ordinarily utilized receptive colors. Not at all like procion MX colors, these colors could just work in a marginally hotter temperature (40-48°C), stay dynamic and could be put away and utilized later. Cibron F colors additionally are known to flexibly a straightforward wash quickness. Discovered to be successful on cellulose strands, fleece and silk.

**Sabracron F:** These are found to figure totally practically like Procion MX colors however must be used in a fairly hotter temperature of (40-48 °C). Sabracron F colors are discovered to be minimal less receptive than Procion MX however they give an incredible wash quickness property. These colors are additionally found to color cellulose strands, fleece and silk.

**Remazol:** Remazol colors are fiber receptive colors that are utilized most ordinarily in painting silk. They can likewise be utilized to color cellulose strands and fleece. Remazol colors are a gaggle of colors that are discovered to be less respond capable contrasted with the inverse receptive colors like procion MX, which makes them more steady in water than procion MX

**Direct Colors:** Direct colors are applied under a fluid shower containing electrolytes and ionic salts. These colors don't shape solid bonds and are inexactly connected with the fiber atoms these colors are applied under temperatures of 79.4 - 93.3 °C. Direct colors are utilized for coloring rayon, material and cellulosic filaments; they could likewise be utilized to color fleece and silk by utilizing synthetic fixative specialists. Favorable

circumstances of these colors is that they are the least expensive among every single other color

**Indigo:** Indigo might be a naval force glasslike powder that is insoluble in water. Diminishing operators like sodium hydrosulfite make it solvent in water. Ordinarily, indigo colors don't have a fondness towards cotton, yet in a diminished state they will in general enter the space in the cotton filaments. The color particles inside the fiber are then presented to air, which makes it insoluble again and effectively caught inside the fiber. These colors are the essential shade of Levis.

**Naphthol:** colors made with combination of two different chemicals: the diazo salts and the naphthol. This combination determines the color of the color. This color is treated as a cold water color. The temperature of cold water used with other groups of colors may range from 35 to 41°C but this type of color can be used even with ice water. Rayon, cotton or other cellulosic fibers as well as silk could be colored using naphthol colors.

**Colors for protein fibers:** Protein fibers are all of the fibers that are obtained from the animals (such as wool and silk). High pH denatures all denaturing proteins and the acid colors are, therefore, wont to color wool, angora, cashmere and the silk thus, applied to respective fabrics along with the acid solutions.

**Azo colors:** Azo tones represent 60-70% of all the shading gatherings and are found to offer out brilliant and extreme focus tones contrasted with the contrary classes of tones found to contain two groups:

the chromophore and  
the auxochrome

Cotton generally, isn't found to bind well with acid or other anionic or cationic colors thanks to the presence of hydroxylic groups in its structure. Hence, simple azo colors are found to be not that effective in coloring cotton.

**Triarylmethane colors:** Triarylmethane colors are the derivatives of tri-aryl-methane hydrocarbon. Acidic triarylmethane colors containing at least two SO<sub>3</sub>H group are wont to color wool and silk fibers. Colors containing just one SO<sub>3</sub>H group are used as indicators (E.g. phenolphthalein). Basic triarylmethane colors are used extensively within the manufacture of stamping inks, writing and printing.

**Anthraquinone colors:** Anthraquinone colors have a sulphonic corrosive gathering which makes them solvent in water. They're wont to shading fleece and silk on account of their partiality towards helper restricting specialists. A subclass of shading called shading tones is wont to shading protein strands and a couple of nylon filaments under warmth. Anthraquinone color's another subclass is named as the fiber reactive color that is employed to color protein fibers. The foremost important and distinguishing characteristics of those colors are the property of forming covalent bonds during the appliance process with the substrates that's to be colored. Unlike other color groups, these colors contain a known chromophore system which contains various reactive groups. Based on these reactive groups, they're classified into:

Mono-anchor colors,  
Double-anchor colors  
And the Multiple-anchor colors

**Colors for synthetic fiber:** The generally utilized colors for manufactured fiber are scattered colors. These colors are chiefly used in the Printing of polyesters, nylon and acetic

acid derivations. Some scattered colors likewise are utilized as printer's ink in businesses. Scattered colors are arranged into three sorts upheld their energy.

The E type (which is low in energy) is employed in the thermosol coloring.

The S type (which is high in energy) is employed in High temperature/pressure coloring.

SE type is convenient for all coloring methods.

Majority of strong squanders originates from the dry processes while the wet one yields only a little amount of strong squanders.

Most of strong squanders are made of bits of textures and bundling textile. The evaporated slime from the material creation is additionally a significant wellspring of strong waste. Strong squanders are not discovered to be unsafe when all is said in done. Be that as it may, the exhausted synthetic compartments may contain hints of unsafe substances. Sources and kinds of strong squanders delivered in mechanical activities and coloring and completing tasks.

Most of the cycles being directed in material businesses produce vaporous discharges. Boilers, broilers and capacity tanks are the three most significant wellsprings of air contamination in the material business. The boilers create Sulfur-oxides and nitrogen. The high temperature material drying measure radiates hydrocarbons. Poisons additionally are produced from buildups of fiber planning during the glow settling measure. Gases can likewise be transmitted from synthetics during the coloring cycle.

**Environmental Impacts of Textile Effluent:** The attributes of material effluents change and rely on such a material fabricated and accordingly the synthetic compounds utilized.

The textile wastewater effluent contains:

Large quantity of agents (in form of suspended, dissolved solids),  
Biological Oxygen Demand (BOD)  
Chemical Oxygen Demand (COD),  
Other chemicals,  
Odor and color.

Generally, BOD: COD proportions are discovered to be around 1:4, subsequently demonstrating presence of non-biodegradable substances. The material effluents contain follow metals like Cr, As, Cu and Zn, which are fit for hurting the climate.

Colors in water give out frightful shading and may cause sicknesses like discharge, and different skin issues and can hinder the infiltration of daylight from water surface forestalling photosynthesis. Colors likewise increment the BOD of the accepting water and progressively diminish the reoxygenation cycle and henceforth hamper the development of photoautotrophic living beings. The suspended strong fixations inside the effluents assume vital function in influencing the climate as they consolidate with sleek rubbish and meddle.

### **Tanneries**

The worldwide interest for leather, leather items increment step by step, since the worldwide populace and the way of life of individuals increment quickly consistently. During the 1970s, sending out stows away and skins were considered as expected wellspring of acquiring unfamiliar trade and neighborhood work. The majority of the cowhide makers confronted a cut in their profits because of the move of the worldwide tanning industry to the non-industrial nations. Simultaneously agricultural nations expanded in producing unfamiliar trade and nearby work. Regardless of this turn of events, natural contamination made by these

production lines is sizable, uncovering tannery laborers and neighborhood networks to extreme wellbeing risks. Tanning is a basic a piece of the technique for changing over crude stows away and skins into completed cowhide. It includes three sorts of items, viz. crude to end; crude to semi-finish; and semi-finish to wrap up. Cowhide creation innovation has advanced from the business to a completely motorized industry.

The leather and livestock hide items area presently speaks to one among the premier significant areas in India, adding to economy. The business has gone through a basic change during the most recent thirty years, from simply an exporter of staple inside the sixties thereto valuable added items possessing a position of noticeable quality inside the Indian economy as far as unfamiliar exchange, work age and development and is among the most noteworthy ten trade workers for the nation.

Creation of livestock hide in India has been firmly identified with the domesticated animal's populace. India being the nation with the biggest animals' populace has all the way to be the main maker of calfskin on the planet. India has one of the biggest livestock's populace on the planet. Yet, its offer on the planet exchange livestock hide is simply 3.5 percent, regardless of a few great variables, for example, solid crude material base, immense modest workforce and exceptionally created uphold ventures like synthetic compounds. This is a result of the absence of co-appointment among the slaughterhouses and tanneries, wasteful strategy for assortment of remains and conventional technique for relieving the calfskin.

**Leather Industry and Waste Water:** In leather manufacturing, the most outstanding process is tanning. Specific Requirements of tanneries:

Raw material (hide, fell or skin) and  
The tanning system, which depends on the  
tanning substance (mineral or organic nature).

Classification according to stages of  
production:

Complete tanneries, starts from raw hide to  
produce finished leather.

Beam-house tanneries, starts from raw hide  
up to tanning step

Wet-end and finishing tanneries, starts from  
leather (wet-blue) to produce crust or finished  
leather.

The creation of completed calfskin from  
crude covers up and skins can be gathered  
under three significant tasks,

beam house  
tanning and  
Post- tanning operations.

The phases of shroud readiness (cleaning and  
molding treatment for tanning), likewise on  
the grounds that the transportation and  
obsession of tanning and adjusting substances  
into collagen structure are completely done in  
fluid media. Large portions of the means in  
these cycles are completed with new water,  
which is utilized as vehicle for dissemination  
of substance items and extraction of  
unfortunate material from the cover up.

**Leather Production in India:** Major  
production centers for leather and leather  
products in India are located in

Tamil Nadu region 6 cities namely Chennai,  
Ambur, Ranipet, Vaniyambadi, Trichy  
and Dindigul;

West Bengal region it's in Kolkata;

Uttar Pradesh region 3 cities Kanpur, Agra  
and Noida;

Maharashtra region it is in Mumbai;

Punjab existing in Jalandhar;

Karnataka it's in Bangalore;  
Andhra Pradesh, Hyderabad;  
Haryana region 4 cities Ambala, Gurgaon,  
Panchkula, Karnal;  
And in Delhi.

### **Process stages**

According to the Reports of the Central  
Leather Research Institute and the State  
Pollution Control Board, Chennai, the number  
of tanneries situated in India is given below  
along with its percentages

The processing of raw (green, chilled or  
chemically cured) and salted (dry or wet  
salted) hides and skins is divided into two  
sections, namely, the beam house and the tan  
yard section, with numerous processing  
occurring in each of the section:

### **Beam house (or lime yard) section**

**Soaking:** It once again introduces water into  
the covers up and skins, cleans out any  
additives (typically salt), blood, fertilizer, pee  
and earth, and relax the stows away and skins  
for ensuing handling.

**Green fleshing:** Fleshing is the mechanical  
ejection of fats and tissue from inside stows  
away or skins. Fleshing can be refined  
beforehand or in the wake of liming, and there  
are focal points and shortcomings to each.  
From a characteristic perspective, green  
fleshing is best as the tissue isn't dirtied with  
engineered materials, and the proportion of  
artificial materials needed for unhairing and  
liming are lessened. This reduces the  
proportion of engineered substances in the  
exuding from downstream cycles.

**Liming and Unhairing:** Unhairing and  
liming measures are generally done at the  
same time. Synthetic substances are utilized  
to:

Partially hydrolyze polypeptides to relax structure of hide/skin.

Soluble globular proteins.

Sponify fats.

Swell hides.

In case of sheepskins, wool can be recovered as byproduct by the process known as paint unhairing.

**Lime fleshing:** Lime fleshing is like green fleshing, yet it happens subsequent to unhairing and liming. The nature of escapes lime fleshing is regularly better than those created utilizing green fleshing. Lime fleshing is the technique for decision in tanneries.

**Lime splitting and trimming:** Splitting is a type of managing where the cover up is precisely partitioned into a grain layer and a substance layer. This can be cultivated in the wake of liming or chromium tanning. A few decorations may likewise be handled to livestockshide. Lime parting diminishes the measure of synthetic compounds needed in downstream cycles. Parting and shaving are generally performed subsequent to tanning.

### **De-liming and bating**

These are the processes that use the chemicals and the enzymes

It removes the residual chemicals also reduces the livestock's hides and livestock's skins pH value.

It also softens the livestock's hides & skins to assist penetration of chemicals in ensuing process stages.

### **Tan yard section**

**Degreasing:** Excessive amounts of grease in

the hide or skin may cause non-uniform penetration of tan or color. This causes complications with the finishing processes and creates dark and greasy patches on the finished leather. Degreasing is particularly important before chrome tanning as chromium salts can react with the greases and form insoluble chromium soaps, which are very difficult to remove.

**Pickling:** Pickling is a chemical process whereby:

To lower the pH to 2- 3, acids are added for better penetration of tanning synthetics.

Adding Salt for hide prevention from swelling under the acidic conditions.

In the case of pickled sheepskins, the picking process preserves the skin and is the final processing step.

**Tanning:** It is cultivated by adding tanning synthetics into a drum containing the stows away for a proper time span. A large portion of the 'leather' is exchanged as wet blue. On account of wet blue, the tanning specialist is trivalent chrome tanning salts. On account of wet white or without metal calfskin, glutaraldehyde is utilized as tanning compound. It should be focused on that tanneries just utilize trivalent chromium, that has been discovered to be non-harmful.

**Basification:** The adding of a gentle soluble base into the tanning drums to guarantee authoritative of the tanning substance to the livestock hide/skin. Subsequent to tanning, a last wash is done to eliminate any unbound synthetic compounds from livestock hide/skin.

**Table.1** Types of waste produced from different processes[2]

Process	Emission	Wastewater	Solid Wastes
Fibre preparation	Little or none	Little or none	Fibre waste and packaging waste
Yarn spinning	Little or none	Little or none	Packaging wastes, sized yarn, fibre waste, cleaning and processing waste
Slashing/sizing	VOCs	BOD, COD, metals, cleaning waste, size	Fibre lint, yarn waste, packaging waste, unused starch-based sizes
Weaving	Little or none	Little or none	Packaging waste yarn and fabric scraps, off-spec fabric, used oil
Knitting	Little or none	Little or none	Packaging waste, yarn, fabric scraps.
Tufting	Little or none	Little or none	Packaging waste, yarn, fabric scraps, off-spec fabric
Desizing	VOCs from glycol esters	BOD from sizes lubricants, biocides, anti-static compounds	Packaging waste, fibre lint, yarn waste, cleaning and maintenance materials
Scouring	VOCs from glycol ester and scouring solvents	Disinfectants, insecticide residues, NaOH, detergents oils, knitting lubricants, spin finishes, spent solvents	Little or none
Bleaching	Little or none	H <sub>2</sub> O <sub>2</sub> , stabilizers, high pH	Little or none
Singeing	Small amount of exhaust gases from the burners exhausted with components	Little or none	Little or none
Mercerising	Little or none	High pH, NaOH	Little or none
Heat setting	Volatilisation of spin finish agents-synthetic fibre manufacture	Little or none	Little or none
Dyeing	VOCs	Metals, salt, surfactants, organic processing assistants, cationic materials, colour, BOD, COD, sulphide, acidity/alkalinity, spent solvents	Little or none
Printing	Solvents, acetic acid- drying and curing oven emission combustion gases	Suspended solids, urea, solvents, colour, metals, heat, BOD, foam	Little or none
Finishing	VOCs, contaminants in purchased chemicals, formaldehyde vapours, combustion gases	COD, suspended solids, toxic materials, spent solvents	Fabric scraps and trimmings, packaging waste

**Table.2(a): Water consumption by processing of different fabrics.**

Processing Subcategory	Water Consumption (m <sup>3</sup> / ton fibre material)		
	Minimum	Median	Maximum
Wool	111	285	659
Woven	5	114	508
Knit	2	84	377
Carpet	8.3	47	163
Stock/yarn	3.3	100	558
Nonwoven	2.5	40	83
Felted fabric finishing	33	213	933

**Table.2(b): Water consumed by different process.**

Process	Water Consumed (%)
Bleaching	38
Dyeing	16
Printing	8
Boiler	14
Other uses	24

**Table.2(c): Water consumed by different process in tanning.**

Process	Water Consumption (L/1000 kg of products)
Sizing	500-8200
Desizing	2500-21000
Scouring	20000-45000
Bleaching	2500-25000
Mercerizing	17000-32000
Dyeing	10000-300000
Printing	8000-16000

**Table.2(d): Water requirements for various process**

Process	Water Requirements (L/1000 kg of products)				
	Rayon	Acetate	Nylon	Acrylic/ Modacrylic	Polyester
Scouring	17000-34000	25000-84000	50000-67000	50000-67000	25000-42000
Salt bath	4000-12000	-	-	-	-
Bleaching	-	33000-50000	-	-	-
Dyeing	17000-34000	34000-50000	17000-34000	17000-34000	17000-34000
Special finishing	4000-12000	24000-40000	32000-48000	40000-56000	8000-12000

**Table.2(e): Chemical requirement during bleaching**

Chemical	Utilization (kg/100kg of cloth)	
	Soft Flow Machine	Winch
Wetting agent	0.5	0.5
Caustic soda	2.5	4.0
Peroxide	3.0	4.0
Lubricants	0.2	0.3
Stabilizers	0.2	0.3
Peroxide killer (oxidizing agent)	1.0	1.0
Acetic acid	2.0	2.0

Table.3(a): Overall Chemical Requirement During Dying.			Table.3(b): Solid Waste Generated From Different Sources.	
Chemicals	Utilization (kg/100 kg of cloth)		Source	Type of Solid Waste
	Soft Flow	Winch		
Lubricants (kg)	0.3	0.4	Mechanical operations of cotton and synthetics	
Sequestering agent (kg)	0.6	1.0	Yarn preparation	Fibres and yarns
Dye stuff (kg)			Knitting	Fibres and yarns
Light Shade	0.150	0.150	Weaving	Fibres, yarns and cloth scraps
Medium Shade	1.5	1.5	Dyeing and finishing of woven fabrics	
Dark Shade	10.0	10.0	Sizing, desizing, mercerizing, beaching, washing and chemical finishing	Cloth scraps
Soda ash (g/L)			Mechanical finishing	Flock
Light Shade	6.0	6.0	Dyeing/printing	Dye containers
Medium Shade	11.0	11.0	Dyeing/printing (applied finish)	Chemical containers
Dark Shade	20.0	20.0	Dyeing and finishing of knitted fabrics	Cloth scraps, dye and chemical containers
Sodium chloride (g/L)			Dyeing and finishing of carpets	
Light Shade	15.0	15.0	Tufting	Yarns and sweepings
Medium Shade	45.0	45.0	Selvage trim	Selvage
Dark Shade	90.0	90.0	Fluff and shear	Flock
Acetic acid (kg)	2.5	3.0	Dyeing, printing and finishing	Dye and chemical containers
Soap (kg)	1.0	1.0		
Fixing (kg)	1.0	1.0		
Softener (kg)	2.0	2.0		

Table.3(c): Pollutants Emitted From Different Process.			Table.3(d): Characteristics Of Typical Untreated Textile Wastewater	
Process	Source	Pollutants	Parameter	Range
Energy production	Emission from boiler	Particulates, nitrous oxides(Nox), sulphur dioxide (SO <sub>2</sub> )	pH	6-10
Coating, drying and curing	Emission from high temperature ovens	Volatile organic components (VOCs)	Temperature (°C)	35-45
Cotton handling activities	Emission from preparation, carding, combing and fabrics manufacturing	Particulates	Total dissolved solids (mg/L)	8,000-12,000
Sizing	Emission from using sizing compound (gums, PVA)	Nitrogen oxides, sulphur oxide, carbon monoxide	BOD (mg/L)	80-6,000
Bleaching	Emission from using chlorine compound	Chlorine, chlorine dioxide	COD (mg/L)	150-12,000
Dyeing	Disperse dyeing using carriers sulphur dyeing Aniline dyeing	Carriers H <sub>2</sub> S Aniline vapours	Total suspended solids (mg/L)	15-8,000
Printing	Emission	Hydrocarbons, ammonia	Total Dissolved Solids (mg/L)	2,900-3,100
Finishing	Resin finishing heat setting of synthetic fabrics	Formaldehydes Carriers – low molecular weight Polymers- lubricating oils	Chlorine (mg/L)	1,000-6,000
Chemical storage	Emission from storage tanks for commodity and chemicals	Volatile organic components (VOCs)	Free chlorine (mg/L)	<10
Waste water treatment	Emission from treatment tanks and vessels	Volatile organic components, toxic emissions	Sodium (mg/L)	70%
			Trace elements (mg/L)	
			Fe	<10
			Zn	<10
			Cu	<10
			As	<10
			Ni	<10
			B	<10
			F	<10
			Mn	<10
			V	<10
			Hg	<10
			PO <sub>4</sub>	<10
			Cn	<10
			Oil & grease (mg/L)	10-30
			TNK (mg/L)	10-30
			NO <sub>x</sub> -N (mg/L)	<5
			Free ammonia (mg/L)	<10
			SO <sub>4</sub> (mg/L)	600-1000
			Silica (mg/L)	<15
			Total Kjeldahl Nitrogen (mg/L)	70-80
			Color (Pt-Co)	50-2,500

**Table.4(a): Sources Of Water Pollution At Various Stages Of Processing.**

Process	Possible Pollutants	Nature of Effluent
Desizing	Starch, glucose, PVA, resins, fats and waxes do not exert a high BOD.	Very small volume, high BOD (30-50% of total), PVA.
Kiering	Caustic soda, waxes, soda ash, sodium silicate and fragments of cloth.	Very small, strongly alkaline, dark colour, high BOD values (30% of total)
Bleaching	Hypochlorite, chlorine, caustic soda, hydrogen peroxide, acids.	Small volume, strongly alkaline, low BOD (5% of total)
Mercerizing	Caustic soda	Small volume, strongly alkaline, low BOD (Less than 1% of total)
Dyeing	Dye stuff, mordant and reducing agents like sulphides, acetic acids and soap	Large volume, strongly coloured, fairly high BOD (6% of total)
Printing	Dye, starch, gum oil, china clay, mordants, acids and metallic salts	Very small volume, oily appearances, fairly high BOD.
Finishing	Traces of starch, tallow, salts, special finishes, etc.	Very small volume, less alkaline, low BOD.

PVA – Poly Vinyl Alcohol  
 BOD – Biological Oxygen Demand  
 COD – Chemical Oxygen Demand

**Table.4(b): Toxic Aromatic Amines Derivatives From Azo Colors.**

Aromatic Amine Group	Human Carcinogenic Evidences
1-Naphthylamine	Slight/Mixed
2-Naphthylamine	Good
2,5-Diaminotoluene	Slight
3,3'-Dichlorobenzidine	Slight/Mixed
3,3'-Dimethoxybenzidine	Slight/Mixed
3,3'-Dimethylbenzidine	Slight
4-Biphenylamine	Good
4-Nitrobiphenyl	Slight/Mixed
4,4'-Methylenebis (2-chloroaniline)	Slight
Auramine	Slight
Benzidine	Good
Magenta	Slight
N-Phenyl-2-naphthylamine	Slight
N,N-Bis(2-chloroethyl)-naphthylamine	Good

**Table 04(c): Typical Pollution Loads From The Processing Of 100% Cotton.**

Process	pH	SEV (l/kg)	BOD	COD	TSS	TDS	Oil&Gas	pH
kg per 1000 kg of product								
<b>Desizing</b>								
Enzyme starch	6-8	2.5-9	45.5	91	89	5	5	6-8
Acid starch	6-8		45.5	91	89.5	7.5	5	6-8
Polyvinyl alcohol (PVA)	6-8		2.5	5	5	48	2.5	6-8
Carboxymethyl cellulose (CMC)	6-8		4	8	5	45	9.5	6-8
<b>Scouring</b>								
Unmercerised greige fabric	12.5	2.5-43	21.5	64.5	5	50	40	12.5
Mercerised greige fabric	12.5		16.5	49.5	5	50	30	12.5
<b>Mercerising</b>								
Greige fabric	12	231-306	13	39	5	148	10	12
Scoured fabric	12		4	12	5	148	-	12
Bleached fabric	12		2	6	5	148	-	12
<b>Bleaching</b>								
Hydrogen peroxide	9-12	2.5-124	0.5	2	4	22	-	9-12
Sodium hypochlorite	9-12		1	4	4	5	-	9-12
<b>Dyeing</b>								
Fibre reactive HE dyes (woven)	12		6	24	-	180		12
Basic	6-7.5	149-300						6-7.5
Direct	6.5-7.6	14-53						6.5-7.6
Vats	5-10	8.3-166						5-10
Sulphur	8-10	24-212						8-10

SEV - Specific Effluent Volume

**Table 03(d): Pollution Load From The Processing Of 50/50 Cotton-Polyester Blend.**

Source	Effluent (l/kg)	pH	COD	BOD	TS	SS	TDS
kg per 1000 kg of product							
<b>Desizing</b>							
Starch	12.5	6-8		38.5	97	77	20
PVA	12.5	6-8		2.5	55.4	5	50.4
CMC	12.5	6-8		3.93	59.5	5	54.5
Mixture	4.2		74		78		
<b>Scouring</b>							
Unmercerised	25	12		10.8	14.8	5	9.8
Mercerised	25	12		8.34	14.7	5	9.7
<b>Bleaching</b>							
Peroxide	16.7			1.3	24	4	20
Oxidative-desize-bleach	5.1		23		184		
<b>Mercerising</b>							
Poly/cotton	16.7			3.2	82	5	77
<b>Dyeing</b>							
Disperse-vat	42	12	68	22.8	122		122
Vat	100				150		
Disperse	80				20		
Direct-disperse		6-8	32	10.7			114
Sulphur-disperse		11	68	22.8			69.7
Reactive-disperse		12	41	13.8			192
<b>Printing</b>							
Pigment (woven)		6-8	5	1.26		0.13	2.5
Pigment (knit)		6-8	5	1.26		0.13	2.5
Vat (woven)		10	86	21.5		25	34
Vat (knit)		10	86	21.5		25	35
Machine wash	100						
Screen wash	7						
Hose vessels	30						
Pigment wash	12.5			1	3	0	3
<b>Finishing</b>							
Resin finishing		6-8					22
Resin finishing flat curling		6-8		25	6.32		17.3

**Table 04(e): Pollution Load From The Processing Of Wool.**

Process	pH	BOD	TS
Scouring	9-10.4	30,000-40,000	1,129-64,448
Dyeing	4.8-8	380-3,000	2,000-10,000
Washing	7.3-10.3	4,000-11,455	4,830-19,267
Neutralising	1.9-9	28	1,241-4,830
Bleaching	6	390	908

**Table 04(f): Pollution Load From The Processing Of Synthetic Fibers.**

Fabric	BOD	COD	SS	TDS
Kg per 1000 kg product				
Rayon	30	52	55	100
Acetate	45	78	40	100
Nylon	45	78	30	100
Acrylic	125	216	87	100
Polyester	185	320	95	150

**Table.5** Number of tanneries across states

Sl.no	States	Number of Tanneries	Percentage Share
1	Tamil Nadu	934	44.67
2	West Bengal	538	25.73
3	Punjab	79	3.78
4	Utter Pradesh	378	18.08
5	Andhra Pradesh	24	1.15
6	Maharashtra	33	1.58
7	Karnataka	16	0.77
8	Bihar	17	0.80
9	Haryana	18	0.86
10	Rajasthan	15	0.72
11	Other States	39	1.86
	<b>Total</b>	<b>2,091</b>	<b>100.00</b>

*Source: Compiled from the Records of the Central Leather Research Institute, Chennai, 2007; and State Pollution Control Board, Chennai, 2007.*

<b>Table 06: Processes under Wet blue and Color house Stages</b>		
<b>Process</b>	<b>Chemicals</b>	<b>Purpose</b>
<b>Wet blue process stages</b>		
Soaking	Biocides, surfactants, degreasers, enzymes	Reintroduce water and washing of chemicals and dirt
Liming and unhairing	Lime, sodium sulphide, sodium hydrosulphide, caustic soda	Chemically remove hair and swell skins
Deliming and bating	Ammonium sulphate, ammonium chloride, formic acid, proteolytic enzymes	Remove lime and calcium Lower pH Soften hide
Pickling	Salt, sulphuric acid, formic acid, sodium formate, fungicide	Lower pH of the hide or skin to allow proper penetration of tanning chemicals
Tanning	Trivalent chrome tanning salts (wet blue) or glutaraldehyde (wet white)	Tanning
Basification	Magnesium oxide and sodium bicarbonate	Ensure binding of tanning chemicals to hide or skin
<b>Dyehouse process stages</b>		
Washing	Surfactants	Reintroduce water Soften and remove shavings, oils or greases
Neutralisation	Sodium bicarbonate, sodium formate	Increase pH to allow chemical penetration
Retanning	Syntans, resins, vegetable tannins	Give specific leatherlike properties
Dyeing	Dyestuffs	Give the desired colour
Fatliquoring	Fatliquors (emulsified oils)	Soften leather and make it flexible
Fixation	Formic acid	Lower pH to ensure chemical binding of the chemicals in the previous steps

**Table 07(a): Pollution loads discharged Summary in Effluents from the individual processes**

Operation	Techno-logy	Pollution load (kg/t raw hide)								
		SS	COD	BOD <sub>5</sub>	Cr	S <sup>2-</sup>	NH <sub>3</sub> -N	TKN	Cl <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup>
Soaking	C	11-17	22-33	7-11	-	-	0.1-0.2	1-2	85-113	1-2
	A	11-17	20-25	7-9	-	-	0.1-0.2	1-2	5-10	1-2
Liming	C	53-97	79-122	28-45	-	3.9-8.7	0.4-0.5	6-8	5-15	1-2
	A	14-26	46-65	16-24	-	0.4-0.7	0.1-0.2	3-4	1-2	1-2
Deliming, Bating	C	8-12	13-20	5-9	-	0.1-0.3	2.6-3.9	3-5	2-4	10-26
	A	8-12	13-20	5-9	-	0-0.1	0.2-0.4	0.6-1.5	1-2	1-2
Tanning	C	5-10	7-11	2-4	2-5	-	0.6-0.9	0.6-0.9	40-60	30-55
	A	1-2	7-11	2-4	0.05-0.1	-	0.1-0.2	0.1-0.2	20-35	10-22
Post-Tanning	C	6-11	24-40	8-15	1-2	-	0.3-0.5	1-2	5-10	10-25
	A	1-2	10-12	3-5	0.1-0.4	-	0.1-0.2	0.2-0.5	3-6	4-9
Finishing	C	0-2	0-5	0-2	-	-	-	-	-	-
	A	0-2	0	0	-	-	-	-	-	-
Total	C	83-149	145-231	50-86	3-7	4-9	4-6	12-18	137-202	52-110
	A	35-61	96-133	33-51	0.15-0.5	0.4-0.8	0.6-1.2	5-8	30-55	17-37

COD Chemical Oxygen Demand, BOD<sub>5</sub> Biological Oxygen Demand (in five days), SS Suspended Solids, TKN Total Kjeldahl Nitrogen

**Table 07(b): Typical values of Tannery waste water Treatment efficiency for Conventional process**

Parameter	COD		BOD <sub>5</sub>		SS		Chrome	S <sup>2-</sup>	TKN	
	% or mg/l	%	mg/l	%	mg/l	%	mg/l	mg/l	%	mg/l
<b>Pretreatment</b>										
Grease removal (dissolved air flotation)	20-40									
Sulphide oxidation (liming and rinsing liquors)	10							10		
Chromium precipitation							1-10			
<b>Primary treatment</b>										
Mixing + sedimentation	25-35			25-35		50-70		20-30		25-35
Mixing + chemical treatment + sedimentation	50-65			50-65		80-90		2-5	2-10	40-50
Mixing + chemical treatment + flotation	55-75			55-75		80-95		2-5	2-5	40-50
<b>Biological treatment</b>										
Primary or chemical + extended aeration	85-95	200-400	90-97	20-60	90-98	20-50	<1	<1	50	150
Primary or chemical + extended aeration with nitrification and denitrification	85-95	200-400	90-97	20-60	90-98	20-50	<1	<1	80-90	30-60

COD Chemical Oxygen Demand, BOD<sub>5</sub> Biological Oxygen Demand (in five days), SS Suspended Solids, TKN Total Kjeldahl Nitrogen

Fig.1(a) Leather industries and toxic chemicals released in nature

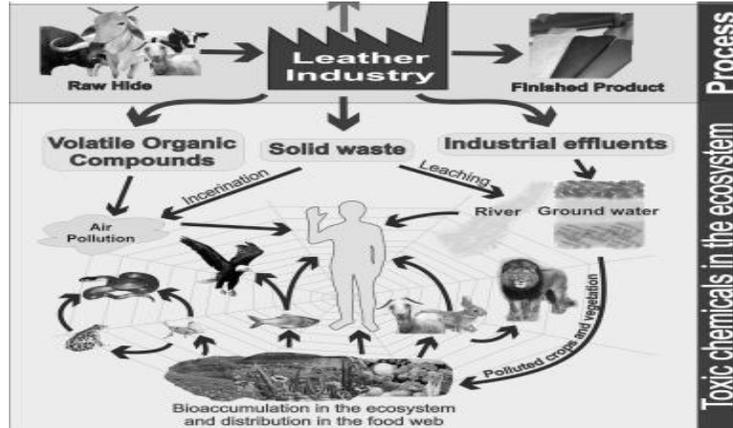


Fig.1(b) Map showing location of tanneries in India



Fig.2 Sections and sub-sections of various processes

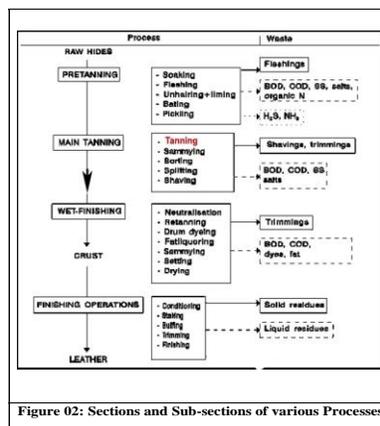
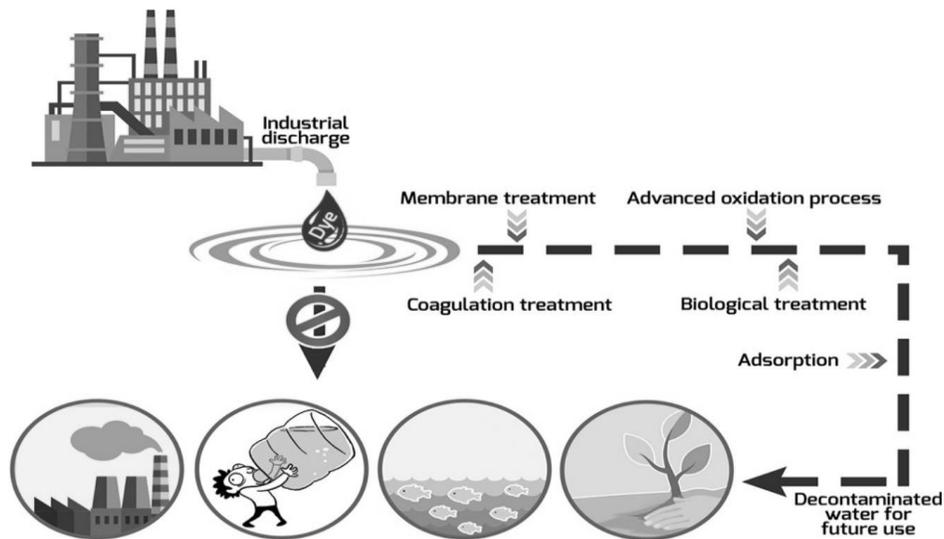


Fig.3 Desire to create this situation



**Sammying:** Mechanical expulsion of water from the wet blue or wet white to a dampness substance of roughly half. Drying the shrouds builds the viability of the downstream parting and shaving measures.

### Color-house Process Stages (wet finishing and dry finishing)

**Splitting and shaving:** These are mechanical techniques used to lessen the thickness of the stow away or skin to the thickness needed in the last calfskin. Parting subsequent to tanning is known as chrome parting.

**Washing:** Skins/hides are washed to remove leftover from splitting & shaving in water.

**Neutralization:** Neutralization is the increasing of pH of wet blue/white to allow synthetics penetration in succeeding process stages.

**Retanning:** Introduction of various sorts of compound into the wet blue or wet white that confer explicit properties (such as flexibility, fullness and texture) on final leather.

**Dyeing:** Addition of powder/liquid colors in order to give the final leather the demanded or desired color.

**Fat liquoring:** Addition of emulsified oils used to soften the leather and make it flexible.

**Fixation:** It is the synthetic binding of all Retanning synthetics, colors and fat liquors to leather by decreasing the pH by the use of formic acid in the drum.

**Final wash:** The last wash is done to clean out any remaining unbound synthetic substances from the shading house measures.

### Drying, mechanical finishing and coating

In the wake of drying, further completing of the calfskin can be performed to accomplish the ideal item.

**Types of Colors Used In Leather Industries:** Calfskin coloring for the most part includes the utilization of soul or liquor based colors where liquor rapidly gets retained into saturated livestock's hide.

Calfskin coloring details are like enamels. They comprise of a color or shade, a casein or nitrocellulose sap, and a dissolvable.

The sorts of color stuff that are utilized by tanneries for the most part differs relying upon the item range required alongside the directs of the style world. Each tannery utilizes between 50-100 or more various kinds of colorstuffs. The calfskin business basically utilizes anionic color that can be separated in the accompanying families:

- Acid colors
- Mordant colors
- Direct colors
- Basic Colors, their use is to a limit.
- Pre-metaled colors
- Solubilized Sulphur colors

Reactive colors although it's a part of the anionic group of colors but the use is limited upto a certain limit.

In the event that we see from the synthetic perspective the colors utilized are generally Azo colors, Anthraquinone colors and Triphenylmethane colors. Industrially, well known Black colors represent almost 60-70% of all livestockshide coloring. Additionally, out of this a color assortment called Acid Black 210 rules with 80-90% use of the entirety of the dark colors utilized.

### **Objective**

As we can see from the above process, their demands for water and with rapidly increasing industrialization which is directly linked to demand. I am trying to design a new process for textile and tannery wastewater treatment and we can see from the above processes that the common effluent discharge is basically composed of colors including heavy metal which are harmful for human as well as all living surrounding either directly

or indirectly. Regarding my Bachelors Project work, have worked on household waste management considering Kanpur chapter. During all these years of work and research, I have become keenly aware of the urgency of environmental issues, especially for our country. Among all the issues, the wastewater problem might be the worst. Partly because of the lack of adequate public attention and appropriate government legislation and policy in the past decades, wastewater treatment in India becomes far behind developed countries so I want to work regarding textile(Varanasi) and tannery/leather industry (Unnao, Kanpur) as it can be found on Ganga belt affecting majority of the northern India region as Ganga belt(covering large area)and I will try my best providing a new economically feasible design which will help industry and the people (Table 1–5 and Fig. 1–3).

In conclusion the investigations demonstrated that textile wastewater can cause hemorrhages, skin ulceration, stress and dermatitis. Synthetic compounds present in water can obstruct sunlight and thus increment of the natural contamination in the water in this manner hindering photosynthesis and re-oxygenation.

In today's era the LI's are confronting some genuine difficulties presented by general society and governments primarily because of the natural contamination and there is a public objection against the business. The significant difficulties looked by LI's are:

Increased cost of leather creation per unit zone because of the rigid ecological guidelines.

Increasing request of crude material for example crude stows away, skins and semi-completed leather.

Lack of APO's and waste treatment advancements in agricultural nations.

Hence I must conclude my assembled data and thanks to my Respective Guide Prof. Dr. Pradeep Srivastava, who helped me a lot and I hope his blessings will shower in future also. I am trying to design a new process which will be mutually benefitting all environmental elements which I'll try to bring in my upcoming publications

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