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# **Optimisation Of An Enzyme Treatment Process For Sheepskins**

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## List of Abbreviations and Terms Used:

**LASRA** – Leather and Shoe Research Association of New Zealand

**1SCrossC** – 1 step cross-current process

**2SCrossC** – 2 step cross-current process

**3SCrossC** – 3 step cross-current process

**4SCrossC** – 4 step cross-current process

**2SCounterC** – 2 step counter-current process

**3SCounterC** – 3 step counter-current process

**Slats** – Processed sheepskins just after washing stages of pre-tanning operations

**Pelts** – Processed sheepskins just after pre-tanning operations

**Green skin** – Raw sheepskins with the wool still not depilated

**Beamhouse operations** – Current industry standard pre-tanning operations using sulphide and lime depilant along with the ‘beam’ knife

**Fellmongery** – Industrial facility in which pre-tanning/beamhouse operations are conducted

**Fellmongering/Pre-tanning operations** – Industrial process of removing valuable wool from raw (or green) wool skins to convert sheepskins into pickled pelts

**Zone 1** – Washing stages of the LASRA process

**Zone 2** – Enzyme treatment stages (including neutralization process) of the LASRA process

**LASRA process** – LASRA enzyme treatment process to be optimized and improved in this work

**Float** – Solution/Suspension of liquid (water and solids) which makes up the aqueous phase in pre-tanning operations

**Product** – Processed sheepskins

**Bating** – A form of enzyme treatment process (using a different enzyme as the LASRA process) following the delimiting process in conventional pre-tanning operations

**Process operation** – A single stage/part of pre-tanning operations e.g. washing stage process operation or enzyme treatment process operation,



# List of Nomenclature Used

$M_{x-yz}$  (units' kg)

Where;

- x - Insoluble solids (IS)
- Total Dissolved Solids (TDS)
- Total Solids (TS)
- Moisture Content (W)
- Grease (G)
- Sulphide (S<sub>2</sub>-)
- Enzyme Dissolved Solids (EDS)
- Total Kjeldahl Nitrogen (TKN)
- Total (T)

And;

- y - Product stream (P)
- Solvent stream (S)
- Effluent stream (E)

And;

- z - 1 to 5 (for stream S and E)
- 0 to 5 (for stream P)

$C_{x-yz}$  (units' kg<sub>x</sub>/kg)

Where;

- x - Insoluble solids (IS)
- Total Dissolved Solids (TDS)
- Total Solids (TS)
- Moisture Content (W)
- Grease (G)
- Sulphide (S<sub>2</sub>-)
- Enzyme Dissolved Solids (EDS)
- Total Kjeldahl Nitrogen (TKN)
- Total (T)

And;

- y - Product stream (P)
- Solvent stream (S)
- Effluent stream (E)

And;

- z - 1 to 5 (for stream S and E)
- 0 to 5 (for stream P)

# ABSTRACT

An enzyme treatment process for the pre-tanning of sheepskins has been previously reported by the Leather and Shoe Research Association of New Zealand (LASRA) as an alternative to current industry operations. The newly developed process had marked benefits over conventional processing in terms of a lowered energy usage (73%), processing time (47%) as well as water use (49%), but had been developed as a “proof of principle”. The objective of this work was to develop the process further to a stage ready for adoption by industry. A process ready for adoption by industry is one that is able to generate good quality products (good quality products are those that has solids removed to industry standards, without visible damages to grain surface, evenly dyed etc.), require minimal changes to plant or operation layout and reduce usage of resources (e.g. water and chemicals).

Mass balancing was used to investigate potential modifications for the process based on the understanding developed from a detailed analysis of preliminary design trials. Results showed that a configuration utilising a 2 stage counter-current system for the washing stages and segregation and recycling of enzyme float prior to dilution in the neutralization stage was a significant improvement. Benefits over conventional processing include a reduction of residual TDS by 50% at the washing stages and 70% savings on water use overall. Benefits over the un-optimized LASRA process are reduction of solids in product after enzyme treatment and neutralization stages by 30%, additional water savings of 21%, as well as 10% savings of enzyme usage.

The optimized (new) LASRA process uses existing equipment and requires no additional outlay of capital. The process is now developed to a point where it should be trialled at industrial scale.

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The LORD God made garments of skin for Adam and his wife and clothed them.

Genesis 3:21 (NIV 2005)

