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Seminar on the Development of
the Leather and Leather Products
Industries in Developing Countries,
Regional Project for Africa

Vienna, Austria, 22 February - 5 March 1971

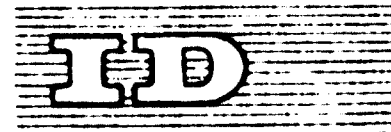
PRESERVATION OF HIDES AND SKINS BY "LOW-VEG" OR "FRINGE LEVEL" TANNING
FOR THE DEVELOPMENT OF AN EXPORT INDUSTRY

by

J. H. Atkinson
F. Soowcroft
Wattle Export Development
London, England

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SUMMARY ^{1/}

PRESERVATION OF HIDES AND SKINS BY "LOW-VEG" OR "FRINGE LEVEL"
TANNING FOR THE DEVELOPMENT OF AN EXPORT INDUSTRY

by

J. H. Atkinson
F. Scovcroft
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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

This paper elaborates some factors which have come to light following the development of this new form of tannage. The tannage, which is suggested, is said to be a suitable form in which to export hides and skins.

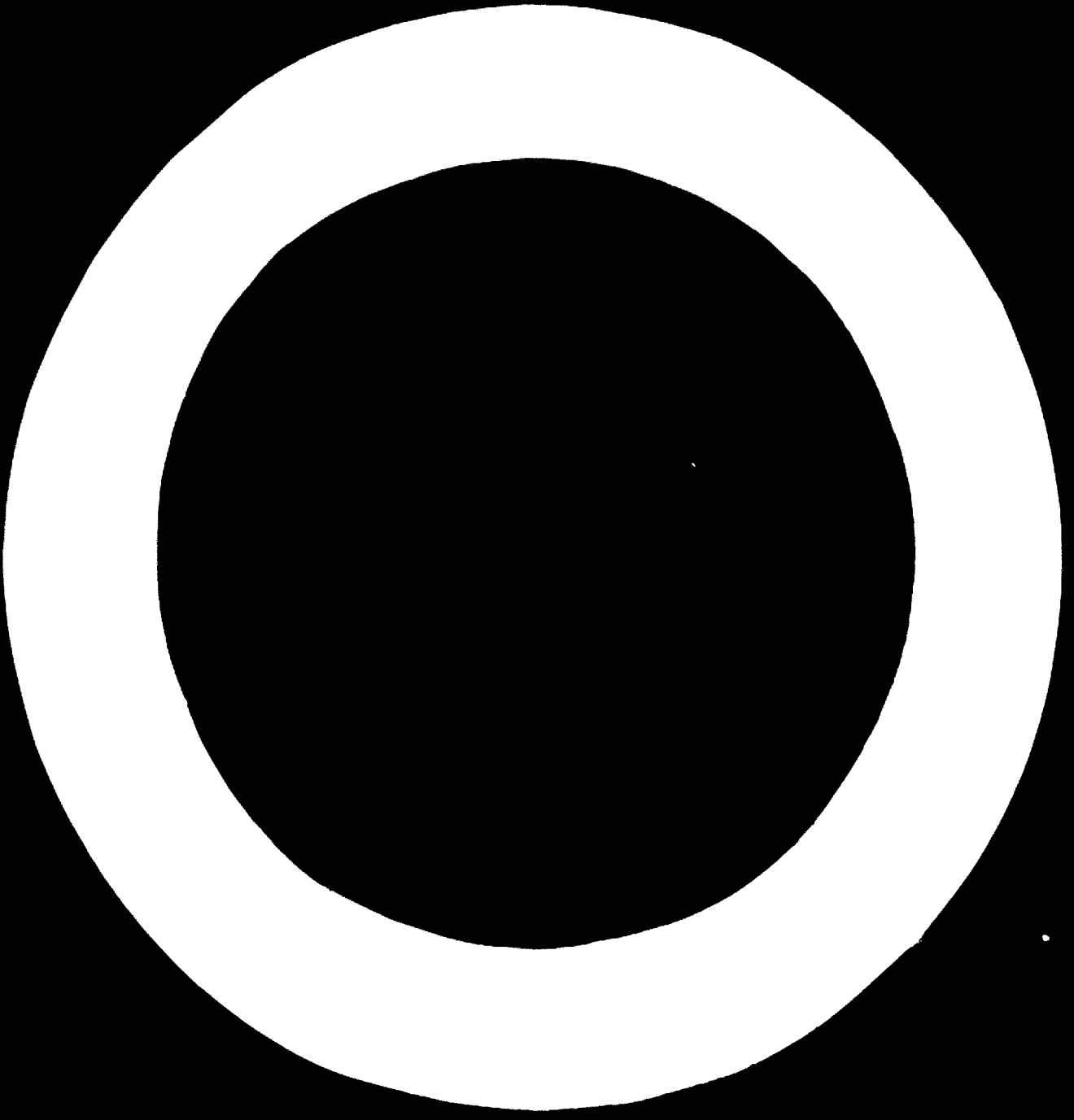
It is said that many of the problems of Wet Blue production/export can be avoided by using this vegetable process. The process uses just sufficient tannin to ensure a non-putrifiable material - using less than one third of the normal tannins offered for producing finished leather.

Factors considered in this paper include: cost of production and freight, both less than wet blue. Yield is also shown to be slightly higher than chrome leather. Material utilization is better as it is said to be applicable to 100 per cent of hides/skins available whereas Wet Blue is said to be suitable for only some 60 per cent of available material. Physical testing results are thought satisfactory.

Market considerations are also reviewed suggesting that as "Low Veg" material is exported dry it should be easy to measure and simple to wetback and reprocess. The material allows the production of most types of leather as the retannages employed by the finishers in the consumer markets appear to override the minimal original vegetable character. Thus "low level" veg leathers can be processed into shoe uppers - garment leathers and even sole leathers.

A newer development of the chrome after-treatment of the material shows that stripping is unnecessary and it is possible to wet back and chrome the material simultaneously giving an instantaneous tannage with no effluent for this part of the process.

It is stressed that this type of tannage "Low Veg", exported then chromed, yields a product which may be viewed as "a full chrome tannage on vegetable extract preserved skins or hides".



The object of this paper is to discuss "low-veg" or "fringe level" tanning as a method of pre-treating and preserving hides and skins which can either be finished in the country of origin or exported in the "fringe level" tanned state for finishing in the importing countries.

It is considered that the process can be used in those countries which:

- a) are at present exporters of hides and skins either in the raw or wet blue form,
- b) have access to supplies of spray dried vegetable tanning extracts or an equivalent,
- c) have the aim of developing a profitable industry which adds work content to local raw materials, to employ the maximum economic amount of local labour and to eliminate the need for sophisticated control.

The relative merits of the various traditional and modern processes for preparing hides and skins for export were compared in a previous paper¹. The methods discussed and the criticisms levelled against them included:

1. Curing

- a) Wet Salting: Careful control is necessary to prevent

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bacterial attack which can give rise to "red heat". The resultant hides and skins contain approximately 50% of water and therefore involve high transport costs.

b) Brining: This process has a high salt usage and in addition suffers from the disadvantages described under "wet salting".

c) Dry Salting: Care must be taken to ensure that the drying out is gradual and even or gelatinisation may occur devaluing the product.

d) Drying: If the process is not carried out properly then putrefaction and gelatinisation may occur. In addition selection is difficult and the material is troublesome to wet back.

2. Pickling

The process involves the possible loss of hide substances. The product tends to be greasy and action on the fibres by the acid during storage gives problems during reprocessing.

3. Wet Blue Chrome Tanning

Chemical reaction continues in the product during storage. The product has a high moisture content and involves high packaging and transport charges.

4. Crust Vegetable Tanning

This process has been carried out for some two

hundred and fifty years in Madras, India², and if properly employed should eliminate all the problems encountered in the processes previously mentioned.

The reason in fact why crust vegetable tanned leather is not the ideal solution in practice is simply because it is sold by weight. This had led to overtanning and adulteration. It is necessary to remove the excess tan and adulterants before use by stripping with alkaline solutions. This means the use of another process which gives rise to effluent problems and results in a reduction of fibre strength. As might be expected, efforts have been made and work carried out on processes which endeavour to eliminate all these problems. Mention may be made of a recent development in this field known as "Dry Enzymatic Pickling" described in H. P. Lochel³. This is a sound scientific process but can be fraught with dangers as it requires very careful control. If the preserved hides or skins are wet during transit then enzymatic action can restart as the enzyme remains active during the storage of the pelts. The correct choice of enzyme is also very important. Although it is claimed that only the non-collagen albumens are destroyed by the enzyme employed it should be pointed out that because of their method of production commercial enzymes are not 100% pure strains and therefore the enzyme may not be 100% selective. If this is so then there is a distinct possibility of collagen degradation

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with a consequent loss of yield and leather strength. A major factor in the appreciation of this process is its cost. Although there is not enough specific information about the process, the indications are that it is a more expensive process than any of the others. Enzyme pickling therefore, although it has advantages such as being shipped in the dry state, suffers from disadvantages such as cost and need for careful control.

However, in a programme of work on this subject Wattle Export Development developed the "Fringe Level" concept. It is considered that this process offers the most efficient and economical method of preserving hides and skins for export.

The process can be used for all types of hides and skins and uses only the minimum amount of vegetable tanning extract required to turn a putrifiable into a non-putrifiable material. In terms of quantity this involves the use of only one quarter to one third of the amount of the normal tan offer for producing finished leather.

Fringe Level preserved hides and skins can be used to produce an extensive variety of finished leathers ranging from fancy to sole and mechanical leather. It is considered however that the product should find its widest application in the shoe upper and garment leather industries. This would involve the subsequent chrome tanning of sheep and goat skins and light hides up to perhaps 2.5 - 3.0 mm in substance. Low-veg tanned

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heavy hides are not considered to be suitable for chrome tanning and would find their main outlet in vegetable tanned heavy leathers.

The processing details are as follows:

Soaking - as normal

Liming - as normal

Deliming -

(The percentages given are based on pelt weight)

In drum:

100% water at 25°C

1% Sodium Bisulphite

1% Ammonium Sulphate

Run 2 hours

Drain

Wash for 15 minutes

Drench -

60% Water

6% salt

0.6% sulphuric acid

(pH 3.8 - 3.9)

Conditioning -

Add 1% Chrome Powder

(25% CR_2O_3 , 33% basic)

Drain well.

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Tanning -

Use 7% - 20% spray dried extract
without float depending on type
of hide or skin being processed.

Further treatment -

Remove material from drum without
washing or oiling and hang out to
dry.

Although the process mentions conditioning for all types of hides and skins this is not necessary in the case of sheepskins and may be deleted from the process if required. It is also possible to use conditioning agents other than chrome. It is possible for example to use syntans. Generally, however, cost considerations are such that chrome conditioning is preferable. For example, should an industry as large as the East Indian Madras Kip market adopt some recommendations previously made for pre-tannage of E.I. Kips^d based on a production of 10,000 tons the cost using synthetic tanning agents would be between £420,000 and £1,250,000. It is thought that a more realistic level of treatment involving synthetic tanning materials would be 2% based on pelt weight. The cost of this would be of the order of £170,000. Chrome conditioning for the same tonnage of finished leather would however cost between £25,000 and £54,000.

As mentioned previously the main usages envisaged

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for "fringe level" preserved hides and skins are in the shoe upper and garment leather fields. Wet blue chrome tanned hides and skins are at present an important material, perhaps the most important, in this field and it is therefore of interest to compare the relative merits of the two processes. Important factors to be considered include:

- 1) Production cost.
- 2) Yield and area changes.
- 3) Raw material utilisation.
- 4) Market considerations
 - a) Acceptability
 - b) Adaptability
 - c) Versatility.

Production Cost

The difference may be demonstrated by choosing as an example a country which imports chrome salts and spray dried vegetable tanning extract but has supplies of indigenous hides and skins. For convenience and easy understanding the costs are expressed on the basis of units rather than local currency. As the skin cost is the same in both cases it is only necessary to consider labour and tanning material costs.

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Basis 1,000 lbs. of goatskins.

<u>Item</u>	<u>Wet Blue Chrome</u>	<u>Fringe Level</u>
Labour	140 units	140 units
sodium Sulphide	54 "	54 "
Liming	25 "	25 "
De-liming	10 "	10 "
Bating	30 "	- "
Pickling	40 "	20 "
Tanning	180 "	67 "
Basifying	10 "	- "
Anti-mould	50 "	50 "
	<u>539 "</u>	<u>366 "</u>

It is clear from this example that there is a saving of 32% in the production costs of Fringe Level as compared to those for wet-blue chrome tanning. It is worthwhile noting that the labour costs are the same as the time required for the two processes is more or less the same.

It is also interesting when comparing the production costs of Fringe Level and wet-blues to examine the costs prepared by K. Seshogiri and V. N. Mohammed Hussain⁵ in their paper which examined the relative advantages of exporting wet-blue and vegetable tanned sheepskins (Bombay slaughter house quality). These are set out in the accompanying table and a further column which sets out the comparative costs of the Fringe Level process has been added.

<u>COST OF PRODUCTION AND EXPORT OF:</u>	Column 1 <u>Wet Blue</u>	Column 2 <u>Veg.Tan</u>	Column 3 <u>Fringe Level</u>
Raw Sheep (100 Pieces)	850.00	850.00	850.00
Tanning Materials:			
1. Lime	6.00	6.00	6.00
2. Sodium Sulphide	7.20	2.25	2.25
3. Ammonium Sulphate	0.60	0.75	0.75
4. Bating	4.00	-	-
5. Sulphuric Acid	1.50	0.50	0.50
6. Salt	0.70	1.00	1.00
7. Chrome Extract (-)	22.00	-	2.00
8. Sodium Bicarbonate	2.00	-	-
9. Preservative	2.00	-	-
10. Hypo	-	2.00	-
11. Avaram Bark	-	30.00	-
12. Wattle Bark	-	20.00	-
13. Wattle Extract	-	18.00	11.90
14. Myrabolam	-	11.00	-
15. Oil	-	15.00	-
16. Epsom Salt	-	0.50	-
17. Jaggery	-	1.00	-
18. Bleaching Syntan	-	1.00	-
Total (I and II)	896.00	959.00	875.40
I LABOUR	30.00	65.00	30.00
V FREIGHT & OTHER EXPENSES	30.00	20.00	15.00
TOTAL (I TO IV)	956.00	1044.00	909.40
TANNING MATERIALS (ITEM II)	46.00	109.00	24.40
TANNING COST AS % OF OVERALL	5.4 %	10.4 %	2.7 %
RAW MATERIALS COST AS % OF OVERALL	88.9 %	81.4 %	93.5 %

It can be seen from this cost comparison that with regard to raw material costs Fringe Level is less costly than wet blue which is in turn less costly than the E.I. sheepskin. With regard to labour costs Fringe Level and wet blue are equal and lower than those for the E.I. sheepskins.

It is obvious therefore that at least in the areas referred to that Fringe Level can be produced more economically than wet blue. The costs given show that Fringe Level has a prime cost of 884.0 as compared to 926.0 for wet blue and 1024.0 for the conventional E.I. tanned sheepskin. It is interesting to note that the latter cost includes higher labour charges than for the other two processes. This reflects a tannage time of thirty to forty days as compared to the equivalent number of hours for the other processes. It may also be noted that the freight charges for Fringe Level are half those of wet blue as this is shipped in the dry form as opposed to the wet form of the chrome tanned product.

Area and Yield

Nayudamma in his paper "Crust Leathers for Export - Some Problems" states that while for wet blues the area is the same as that of the soaked area of the raw skin, vegetable crust leathers show a gain in area of 2 - 6%. Further, in the work described, although the wet blue showed no loss of area when produced, when the material was stored for only fifteen days a loss of 4% was recorded. In similar trials

on the crusted chrome material a loss of 9% was recorded. It would therefore appear that wet blue chrome has an area which is 6 - 10% less than vegetable tanned crust while chrome crust has an area which is 11 - 15% smaller. Nayudamma states: "the above data therefore confirm the trade preference of vegetable tanned crust leather to chrome crust."⁶

An intensive investigational study has been carried out recently by W.E.D. on many aspects of the processing of "wet blue", "Fringe Level" and "Full Veg" leathers. The results of this confirm those of Nayudamma's study. However, the W.E.D. experiments also incorporated a study of the changes which occur during processing, not only with regard to area but also substance and weight yield. In these experiments it was necessary to have a well-fleshed and trimmed starting material to achieve accurate results especially in the case of substance measurements. It was considered that the work should be based on the well-fleshed, trimmed, re-limed weight.

The details for experimental work are set out below:

Raw Material - Dry Nigerian Goatskins

Soaking: Soaked in a stationary 1% solution of
Dettol for 48 hours
+ 0.5% Na₂S
Stationary 24 hours
Drum 4 hours
Drained

Lining: Drum 2 RPM

5% Lime

2% Na₂S

Drummed 3 hours

Unhaired

Relining: 5% Lime

Stationary overnight

Fleshed

1% Lime solution overnight.

Deliming: 1% Ammonium Chloride

1% Sodium Bisulphite

Drummed 4 hours pH 7.5

Pelt divided into packs of approximately equal weights and similar substances.

Pickle or Drench

	<u>Blue Chrome</u>	<u>Full Veg.</u>	<u>Fringe Level</u>	
			<u>1</u>	<u>2</u>
Water	100	60	60	60
Salt	10	6	6	6
Sulphuric Acid	1	0.6	0.6	0.6
Drumming	2 hrs.	1 hr.	1 hr.	1 hr.
pH	1.0	3.8	3.8	3.8
	-	Drain	Drain	Drain
+ Chrome	7%	-	-	-
+ Veg.	-	10%	10%	10%
Drumming	3 hrs.	1 hr.	2 hrs.	2 hrs.

Pickle or Drench (Continued..)

	<u>Blue Chrome</u>	<u>Full Veg.</u>	<u>Fringe Level</u>	
			<u>1</u>	<u>2</u>
Basification (pH 4.0)	2.2 NaHCO ₃	-	-	-
Horsed	14 days	Piled 1 day	Dried out	Dried out
			Wet back	Wet back
Tanned	-	-	6% Chrome	20% Veg.
Water	-	-	100%	100%
Drumming			2 hrs.	2 hrs.
Basification	-	-	0.75% NaHCO ₃	-
Horsed			1 day	1 day
Neutralisation	2% NaHCO ₃	-	1% NaHCO ₃	-
	Washed	-	Washed	-
Retannage	3% Chrome	5% Veg.	3% Chrome	9% Veg.
Fatliquor	2% Highly Sulphonated Heatsfoot	4% Burso- line QW	As Blue Chrome	4% Burso- line QW
	2% Low Sulp. Sperm		" "	
Drying	Nailed	Slicked	Nailed	Nailed

N.B. All percentages based on Lined Weight as 100.

In all cases the Vegetable extract used was ME Spray Dried Mimosa Extract, and the chrome used was standard chrome powder 25% Cr₂O₃, 33% Basicity.

The results of the above experiments are set out in

table form below:

BLUE CHROME

	Lined	Delined	Wet Blue	Wet Blue After 14 days	Dry
Area	100	111	88	86	98
Substance	100	71	85	90	69
Weight	100	97	85	84	28

FULL VEG

	Lined	Delined	Tanned	Dry
Area	100	114	97	100
Substance	100	71	104	103
Weight	100	97	104	49

FRINGE LEVEL
(1)

	Lined	Delined	Wet Low Veg.	Dry Low Veg.	Wet Tanned Chrome	Dry
Area	100	112	97	90	97	102
Substance	100	71	100	97	98	91
Weight	100	99	96	35	94	36

FRINGE LEVEL
(2)

	Lined	Delined	Wet Low Veg.	Dry Low Veg.	Wet Tanned Vegetable	Dry
Area	100	115	96	90	98	98
Substance	100	69	97	97	104	104
Weight	100	100	97	35	98	45

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CONCLUSIONS

The figures confirm that wet blue chrome gives less area than Full Veg, especially in the wet state which is the one in which they are sold. They show that even after only a short storage of 2 weeks wrapped in polythene, further losses in area occur; although there is a corresponding slight gain in substance.

Dry Fringe Level tanned goatskins show up well when compared with wet blue chrome and Full Vegetable, in that for freight purposes their weight is reduced to 41% of the weight of wet blue chrome and 70% of the dry weight of the Full Vegetable Tanned Goatskins. Their area is slightly greater than wet blue, but lower than Full Veg. Their substance is significantly greater than wet blue chrome, but once again less than a Full Vegetable.

After reprocessing, with chrome, the dry area of Fringe Level is slightly greater than that of the corresponding reprocessed and dried out wet blue chrome; the substance and weight however are much greater.

Secondly, with vegetable retanned Fringe Level skins, the area and weight yield are slightly less than those of Full Vegetable but the substance is equal.

With Fringe Level hides and skins it is important

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that they are sold by area and not weight, to safeguard them from being over-tanned and adulterated. In order to counter possible objections that some tanners may set the skins out several times to obtain maximum area, giving loss of substance, and the contingent possibility that this substance would not be recovered on subsequent reprocessing, experiments were carried out to determine what the effect of heavy setting was. Two tests were carried out for different conditions. The results are set out below using the lined weight as a reference point.

a) Wet Fringe Level - Set out 3 times during drying

	<u>Lined</u>	<u>Dry Fringe Level</u>	<u>After Chrome Tanning</u>	<u>Dry</u>
Area	100	85	91	78
Substance	100	85	98	103
Weight	100	33	86	34

b) Wet Fringe Level - Set out only once during drying.

	<u>Lined</u>	<u>Dry Fringe Level</u>	<u>After Chrome Tanning</u>	<u>Dry</u>
Area	100	84	92	78
Substance	100	95	99	104
Weight	100	33	84	34

These results show that only a very slight increase in area was achieved by heavy slicking, but there was a large decrease in substance. However, on reprocessing the substance was virtually all regained.

Raw Material Utilisation

The advantages of Fringe Level tanning over wet blue with regard to production costs and area and substance gains have been outlined. There is however a further factor which makes this process attractive to tanners. When producing wet blues the selection required is such that in general approximately 60% of the hides or skins available are suitable. An outlet therefore has to be found for the remaining 40%. In the case of Fringe Level tanning however 100% of the skins or hides can be processed and subsequently selected and graded.

Market Considerations

This aspect can be sub-divided into:

- i) Acceptability,
- ii) Adaptability,
- iii) Versatility.

Acceptability

In most markets wet blue chrome has been accepted but in more discerning markets there is a desire to receive vegetable tanned goods. The reason for blue chrome acceptance was that it was cheaper and more easily converted into shoe uppers than full vegetable tanned leather which had to be stripped of its considerable excess of tan before retanning with chrome. As pointed out before however wet blue does have distinct disadvantages in that it suffers from chemical changes

continued...

in transit and has lower area and substance. Wet blues are also very difficult to measure and malpractices easily arise. Full Vegetable tanned crusts are overtanned and therefore overpriced. The overtanning necessitates a chemical stripping out of the unnecessary but paid for tannin and adulterants which leads to an effluent problem.

Fringe Level has the advantages of lower production cost, greater area and substance, lower freight charges and is chemically stable during transit and storage.

Adaptability

A disadvantage of wet blues is that the chemical reaction continues during transit and storage giving rise to oxidation. This necessitates correctional treatment before further processing. In addition the lack of substance has to be improved by retannage with vegetable extract or expensive resins before being ready for finishing.

Fringe Level overcomes the criticism levelled against full vegetable tanning in so far that it is cheaper, not overloaded and therefore does not need to be stripped chemically and does not cause an effluent problem. It readily wets back for reprocessing with chrome and/or vegetable tanning.

Versatility

It is impossible to produce a full vegetable tanned leather from wet blue chrome but one can produce full vegetable

tanned leather from Fringe Level.

Shoe upper leather can be produced from wet blue by subsequent re-chroming and retanning with vegetable tanning extract and resins. Shoe upper leather can also be produced from Fringe Level tanned material by subsequent re-chroming. Fringe Level can also be processed into garment, upholstery, harness, case and sole leather.

The following results for physical tests carried out by the BLMRA on shoe upper leather produced from Fringe Level light hides may be of interest.

Tensile strength

Two tests carried out at right angles.

Thickness mm.	0.92	0.94
Tensile Strength Kgms. per sq. mm.	2.54	1.87
Elongation at break %	46	48
Breaking Load kgms.	23.4	17.6

Baumann Tear

Thickness mm.	0.97	0.90
Tearing load kgms.	7.6	9.5

Lastometer

Load at grain crack kgms.	14
Distension at crack mm.	5.8
Load at burst kgms.	43
Distension at burst	9.4

Continued...

These results may be summarised as follows: the tear strength is adequate for leather of this thickness; the tensile strength and elongation at break are satisfactory as is the lastometer distension on grain crack.

The many advantages of Fringe Level have been outlined. These are its low production cost, increased area and substance, efficient raw material utilisation and its acceptability, adaptability and versatility. It is however considered that a short description of exactly how hides and skins tanned in the Fringe Level manner are recognised will be of interest.

They are light coloured, light in weight, of good handle, smooth grained and instantaneously wetting back with no leach-out. This permits their use for the light pastel shades which are requested for modern fashions. The skins are immediately available for conventional further tanning processes whether chrome or vegetable. It is worthwhile noting that some of the types of leathers mentioned are now being produced from Fringe Level stock on a limited but increasing commercial scale.

When tanning with chrome not only is it not necessary to strip Fringe Level skins by alkaline means, it is also not necessary to acidify them as the chrome liquor is sufficiently acidic for the chrome tannage to be carried out and basification is reduced to a minimum. An important development of the

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chrome tanning process has been achieved recently by WED in which the wetting back and chroming take place simultaneously thereby ensuring that a virtually instantaneous tannage is achieved without any effluent whatsoever in this ultimate part of the process.

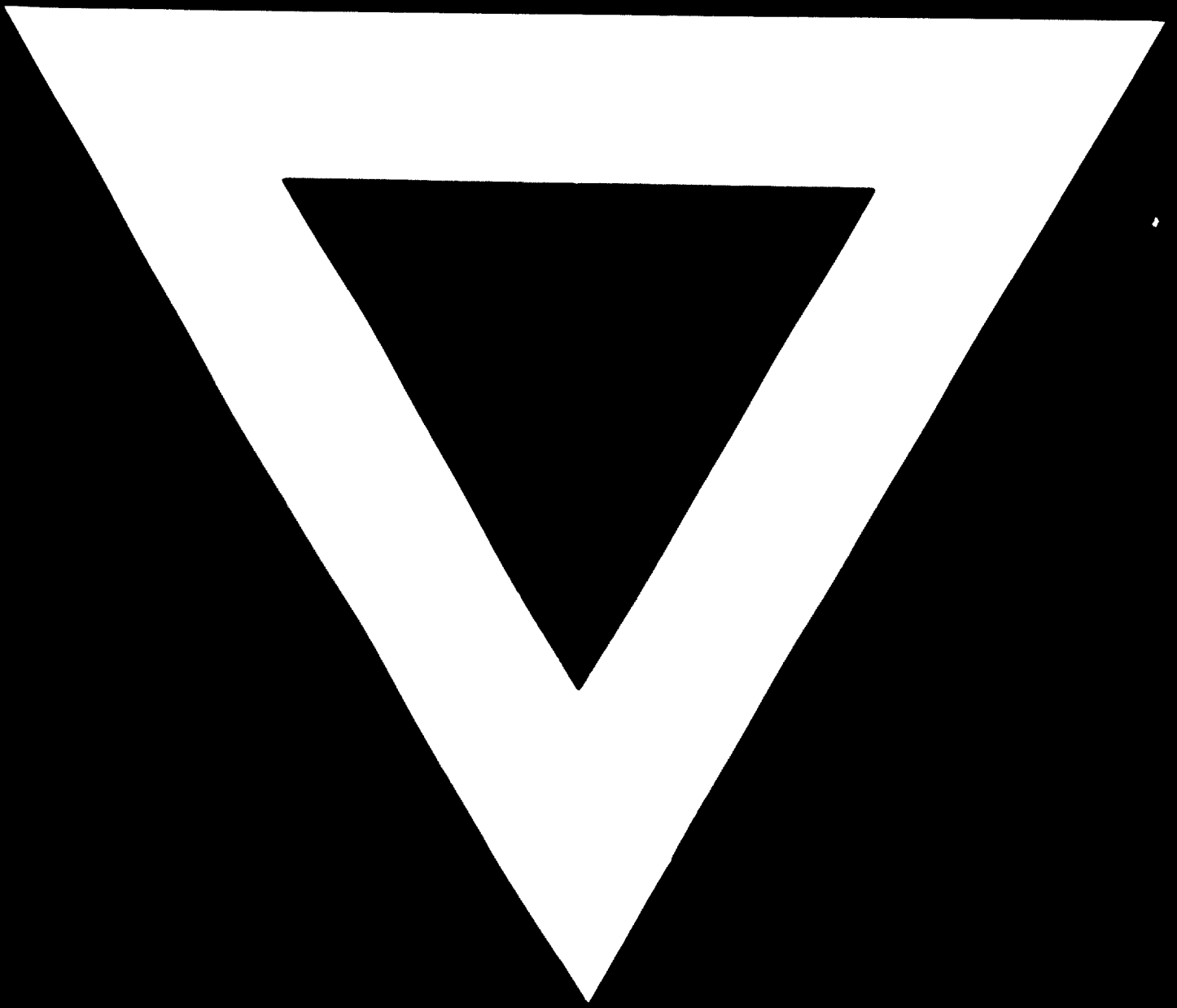
It must be stressed that this type of tannage is a full chrome tannage on vegetable extract preserved skins or hides and is not a semi-chrome tannage. An indication of this is provided by the fact that Fringe Level skins which have been chrome tanned have proved satisfactory for the new waterproofing process developed by P. S. Briggs⁷. This process involves the treatment of chromed skins with a linear di-acidic molecular reaction. It is reasonable to assume from this work that sheep or goat-skins can be used for waterproofed clothing and shoe upper leathers respectively. Work is at present in hand on waterproofing light hides using this process in view of their extensive use in shoe upper manufacture.

It may be concluded that this method of preparing hides and skins for export and its consequent development of a local industry provides the basis for the eventual development of domestic leather industries which will produce finished leather and goods for national and international use.

REFERENCES

1. J. H. Atkinson and F. Scowcroft
"A Modern Concept of Tanning Hides and Skins for Export"
T.E.P.F. Symposium, Bayer, Leverkusen 1970.
2. Shri A. Nagappa Chettiar
Weekly Bulletin of Leather and Shoe News, No.40, Page 4.
3. H. P. Lochel
Dry Enzymatic Pickling, a New Process for the Preservation
of Pelts - Communication presented to the XVIIIth Meeting
of the AQEIC, Sitges, May 1969.
4. J. H. Atkinson and P. G. Bovendeert
Economics of Adopting Rapid Tannage for Vegetable Tanned
Kip Leathers - "Tanners Get Together", Madras, India, 1970.
5. K. Seshogiri Rao and V. M. Mohammed Hussain
Relative Advantages of Exporting Wet Blue and Vegetable
Tanned Sheepskins - Leather, Page 17, June 1969.
6. Dr. Y. Nayudamma and K. T. Sarkar
Crust Leathers for Export: Some Problems - Paper read
to IV Congress Scientific Soc. of the Leather Shoe and
Allied Industries - Budapest, 1970.
7. P. S. Briggs
Waterproofing of Leathers by the New Method invented by
P. S. Briggs - Patents covering the process are held by
the National Research Development Corporation - the commercial
licence is held by Y. B. Bavon Ltd.





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