CHROME TANNING.

By Otto P. Amend.

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Knapp, in 1858, published a paper in which he clearly described a chrome-tanning process. The liquor which he used contained a basic chloride of chromium but he stated that the leather he thus produced did not differ materially from the well-known alum-tanned leather.

The first, so-called chrome leather put on the market was made according to the Heinzerling British patents of 1878.

According to this process, the skins were treated in solutions containing alum, common salt, and a chromate or bichromate of the alkalies or of the alkaline earth metals, and they were afterwards subjected to the action of a benzine solution of stearine or similar fats. No systematic attempt was made to reduce the chromic acid to a tanning form, the product being, at first at least, merely an alum tannage, colored and perhaps somewhat hardened with chromic acid, though on keeping for a length of time, reduction gradually took place at the expense of the hide fibre, and of the fats employed in currying, so that the leather internally became grayish green and really chrome-tanned.

Eitner took out a patent in 1881, in which he described a combination of the basic chromium and iron salts of the formula $Cr\begin{matrix}OH\\SO_4\end{matrix}$ or $Fe\begin{matrix}OH\\SO_4\end{matrix}$. The skins were immersed in a solution of these salts and afterwards treated, in a second bath, with a fatty emulsion, made from animal, vegetable and mineral oils.

The first really important advance in practical chrome-tanning was undoubtedly made by August Schulz in 1884. Schulz treated his skins in a bath containing potassium bichromate plus an acid, until they were saturated, and after this, they were placed in a second bath containing sulphurous acid or hyposulphite of soda plus an acid. This process has since been called the two-bath process. It has since then been used successfully for many years, especially in the manufacture of goat or kid leather and has been greatly perfected. Yet it is rather an uncertain and unsatisfactory process as it does not produce the same leather at all times.

It is almost impossible to tan a heavy cow or steer hide by this process, as the chromic acid in the interior layers of the hide will bleed, or run out, while the hyposulphite is slowly acting upon the outer layers; this, as a matter of course, will produce a leather in which the inner layers remain untanned.

When hyposulphite of soda is used in the second bath of the Schulz process, free sulphur is precipitated in the

skin. Some authors claim that this free sulphur helps to make the leather soft and that this is the main cause for the difference in softness between two-bath and one-bath process leather. I do not agree with the authors referred to, but I think that Fahrion's theory is correct and that the difference in the results obtained by the one-bath process, as compared with those obtained by the two-bath process, is due to the oxidation of the hide fibres which occurs in the first bath of the Schulz process. I am also of the opinion that a similar oxidation occurs in vegetable tannages and is extremely beneficial. In regard to the free sulphur deposited between the hide fibres, it is my opinion that its effect is very harmful and that it is bound to form free sulphuric acid in the hide, by oxidation.

The one-bath process consists in treating the skins with a basic solution of a chromic salt. Such a salt can be produced by adding washing-soda to a chromium salt until sufficiently basic and then heating.

Procter says the solution must not be heated, but, unless heat is used, a complete chemical combination does not take place.

Differences in basicity have an important bearing on the tanning properties of chrome solutions. Chrome alum, on account of its acid character, penetrates the skin quickly, but fails to tan the skin thoroughly, is easily washed out, and produces a leather of a greenish color. When more basic solutions are used, the penetration is slower, the tannage more complete, the chrome less easily washed out and the leather produced is of a more bluish shade. When the solution becomes very basic, the chromium salt will precipitate on dilution (except if diluted in or with such saline solutions as described in my application for patent, but remains stable and perfectly dissolved in a concentrated solution.

Professor Procter has also recommended the use of a basic chromium salt solution, prepared by direct reduction of a bichromate with sugar, in the presence of such a limited quantity of hydrochloric acid as to produce a basic salt. In regard to the reduction of a chromic acid salt with organic matter, I am of the opinion that no one can succeed in making such reductions just alike; reduction with organic matter must be made in the presence of considerable acid and it is impossible therefore to produce a very basic salt by this method.

Glucose and glycerol have been recommended, also, as good reducing agents, but uniform and reliable liquors are best obtained by reducing with some salt of sulphurous acid or with sulphurous acid itself. It must be borne in mind also, that chromium salts of organic acids are worthless as tanning agents and that, as the organic acids which form during the reduction of

the chromic acid with organic substances combine with chromic oxide, this entails a very considerable waste of chrome.

I have examined and analyzed a number of chrome liquors which are now being placed upon the market and I find that nearly all of them are produced by the reduction of potassium or sodium bichromate by means of glycerol, alcohol or glucose, most of them being sulphates. Some are of the formula $Cr_2(SO_4)_3$ + organic acids, while others are of a more basic formula as $Cr_2(SO_4)_2$ + organic acids. Some contain free glucose and others traces of formaldehyde.

The basic chrome salt produced by adding carbonate of sodium to chrome alum or chromium sulphate, while heating, proved to be a very good tanning material. It quickly deposits a very basic chromium sulphate in the skin and leaves a decidedly acid salt in the solution and the color of the skin is pale lilac, almost white.

If a basic sulphate of chromium is used, of the same formula as the above, but prepared by reducing a bichromate or chromic acid by means of sulphurous acid, the skin takes up the basic sulphate as such, and the tanning bath will not show an increase of acid; the color of the skin in this case is a pale bluish green.

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NEW BOOKS.

HIGHER MATHEMATICS FOR STUDENTS OF CHEMISTRY AND PHYSICS WITH SPECIAL REFERENCE TO PRACTICAL WORK. By J. W. MELLOR, D.Sc. Second edition, enlarged. London and New York: Longmans, Green & Co. 1905. 8vo., xxii+632 pp. Price, $4.50.

Since the first edition of this work, which appeared in 1902, has been critically reviewed in this Journal (**25**, 103 (1903)), it is only necessary to call attention to the appearance of a new edition and to the changes that have been made in it. These are fairly extensive ones, but they consist in the revision and expansion of the subjects previously treated and in minor modifications in the order of presentation rather than in the inclusion of new branches of mathematics, or in any radical change in the point of view. Without depreciating the value of the book to advanced students of chemistry and physics, the reviewer wishes to express the opinion that there is no direction in which it could be made of so great service to education as by placing it in the hands of all those teachers of the higher mathematics who lay more stress on the relatively insignificant matter of mathematical technique—such as the more complicated processes of algebraic reduction,