

THE 55TH JOHN ARTHUR WILSON LECTURE: SOME CONSIDERATIONS ABOUT INTERNATIONAL TECHNICAL COOPERATION IN THE TANNING INDUSTRY

by

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FIRST THINGS FIRST: WHY COOPERATE, WHY HELP?

Some thirty-odd years ago, soon after I joined UNIDO, my very forthcoming host and friend, owner of a prestigious Scandinavian tannery, asked me point blank: Why should there be something called international technical assistance? He even asked me did I not feel embarrassed for helping future competitors of our European tanners.

In my defense, my arguments were possibly more along the lines of solidarity and support to poor communities from the typically lowest strata of society living and working in overcrowded tannery clusters in sub-human conditions. Furthermore, I argued that instead of exporting raw hides and skins they had every right to maximize utilization of local resources and process them, not only to pickled, wet blue or crust, but even to the fully finished stage and, who knows, one day even into leather products.

Gradually this thinking considerably evolved, acquired new perspectives and turned into a strong belief that development with all its spin off benefits (employment, education, better living standards, more balanced population growth etc.) is the *conditio sine qua non* for ensuring global stability. And leather produced by tanners' results in substantial employment downstream: some 50 square feet of leather a day corresponds approximately to one job in footwear manufacture.

Furthermore, the claim that a good project easily attracts bank funding, and the know-how can be easily purchased, is not always valid; it is difficult to secure bank loans for a common effluent treatment plant for a tannery cluster in a developing country.

Relocation of capacities is a process that cannot be stopped; it happens regardless, and the only choice for the North is to remain aside and hope to survive or to join in and adjust.

Moreover, pollution prevention and treatment of waste have been among the key ingredients of international technology transfer; ultimately, it also helps level the competition ground.

When it comes to technology transfer UNIDO still rightly enjoys the status of honest broker, a party without any vested commercial interests and guards against consulting companies and manufacturers who often have their own priorities, including unhealthy preferences for hardware over software.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION, UNIDO: SALIENT FEATURES

United Nations Industrial Development Organization, UNIDO, originally established in 1966, is a specialized agency from the UN family; with headquarter in Vienna, Austria. Its basic mandate is to promote sustainable industrial development as an important driver of economic growth and thus contribute towards eradication of poverty. Sustainable development incorporates not only the economic but also the social and environmental dimension: in addition to transfer and absorption of appropriate technologies, creation of decent jobs, advancement of trade etc. it also addresses industry-related environmental and energy challenges. As of 1 January 2014, the Organization had 171 Member States and employed close to 700 staff at Headquarters and other established offices.

UNIDO is to carry out its mandate by performing four complementary functions: technical cooperation; action-oriented research and policy advisory services; standards and compliance; and its convening and partnerships role.

Withdrawal of some important Western states (Australia, in 1993 followed by Canada and USA in 1996 and UK in 2011) was a heavy blow to both UNIDO's position and funding of its regular budget. The explanation given was dissatisfaction with

UNIDO's efficiency and overlapping with activities of some other UN system agencies. The withdrawal of USA meant loss of approximately one quarter of the assessed annual budget. This left Japan as the leading contributor, providing about 20% of the annual budget.

In practice, UNIDO's role is to transfer technology from industrialized countries to developing countries. UNIDO's regular budget, covering staff and operating costs, is funded by contributions from its Member States, by amounts assessed along the principles of the UN system. Programs and projects of technical assistance are mainly funded through voluntary contributions from donor countries and institutions, as well as from multilateral funds.

The largest voluntary contributor in 2012 was once again the European Commission with net approvals (excluding support costs) in project budgets of \$17.2 million, followed by Japan (\$11.7 million), Switzerland (\$10.1 million), Sweden (\$6.1 million), Italy (\$4.7 million), Germany (\$4.6 million), Norway (\$4.4 million) etc. Although not a member, the USA contributed \$1.3 million.

It is not surprising that countries providing voluntary funding call the shots; and their priorities tend to change rapidly, almost from one election to the other: from *training, quality control, environmental protection, child labor* to *Small and Medium Scale enterprises (SMEs), preferably of traditional family and/or artisanal units*. *Direct assistance* to such units may be soon be perceived as interference in the local economy and market twisting. At another time, *institution building* or good governance will be of the highest importance or projects without *women in development (gender equality)* component will not be considered at all. In addition, nearly every new UNIDO Director General launches a new beginning, a new organizational scheme, new reshufflings etc. that in reality very often end with nothing more than some catchy new buzzwords...

Currently, UNIDO has defined three thematic priorities: i) Productive capacity building, particularly for small and medium-sized enterprises (SMEs) post-crisis rehabilitation ii) Trade capacity building, including Corporate social responsibility, (CSR) and iii) Sustainable production and industrial resource efficiency.

The third item has a special weight in view of UNIDO's expertise in industrial environmental management and industry-related implementation of multilateral environmental agreements. In particular, these include the Global Environmental Facility (GEF), the Montreal Protocol (elimination of ozone depleting substances) and the Stockholm Convention Persistent Organic Pollutants (POPs). For the ninth consecutive time UNIDO was once again ranked as the top implementing agency of the Multilateral Fund for the Implementation of the Montreal Protocol.

Despite the withdrawal of several important countries, the volume of technical assistance almost doubled in the last 10 years. With its total staff of less than 700 the actual implementation in 2013 was about 180.6 million dollars, among the highest since UNIDO became a specialized agency. This does not include the value of co-funded projects with UNIDO as a partner (about 206.2 million dollars) and in-kind contributions by recipients, estimated at 173.6 million dollars.

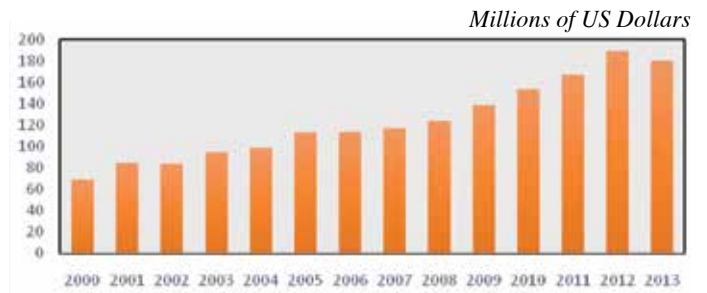


Figure 1. UNIDO technical cooperation delivery 2000 -2013.

The share of implementation according to region and thematic priority are shown in Figures 2 & 3.

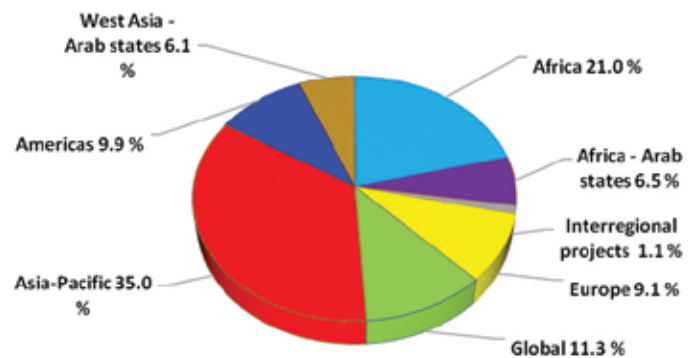


Figure 2. UNIDO technical cooperation delivery (implementation) in 2013, by region.



Figure 3. UNIDO technical cooperation delivery (implementation) in 2013, by thematic priority.

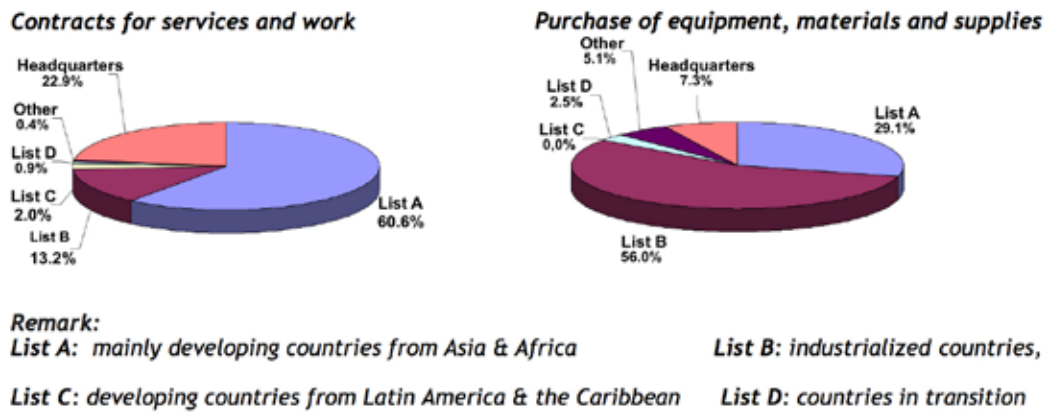


Figure 4. The sources of procurement (services & work and equipment), 2012.

The sources of procurement (services & work and equipment) are shown in Figure 4.

The proportions of appointments of individual national and international experts are quite similar.

Obviously, part of the funding provided by industrialized countries (List B) is compensated by gains derived from the supply of services (including training) and equipment. In some cases a significant share of some voluntary contributions (funding of specific projects) eventually might end up as indirect support to donor's country own equipment manufacturers, consulting companies and/or training institutions. Ultimately, this can further boost the trade between the donor and the recipient country and/or the region.

Almost in parallel with the final stage of some important Western states leaving the organization, China has vigorously and successfully lobbied to have the first Chinese appointed as Director General of UNIDO. This move, together with, for example, China's steadily expanding assistance to Africa might not be a sheer coincidence but rather a part of China's wider strategy of greater involvement in global developments.



Figure 5. A map showing the Least Developing Countries, LDCs.

In this context, the EU initiative to boost the industry to reach the share of 20% of GDP by 2020 could improve the relevance of UNIDO to EU member states.

It would be very encouraging to see the USA administration returning to UNIDO and possibly to have UNIDO technical assistance directed to post-crisis areas and to the Least Developing Countries (LDC)¹ only.

IS THE LEATHER SECTOR RELEVANT, SUSTAINABLE AND WORTH SUPPORT?

According to the official demographic statistics (http://www.geohive.com/earth/his_history3.aspx), the world population was 4,863 million in 1985 and 6,896 million in 2010 giving the growth rate of 1.407%/year.

As per FAO Compendiums for 2003 and 2013, the world total bovine population, 1984-1986 average, was 1,397 million heads and 1,619 million heads in 2010 so that the average growth rate for the same 25 years period was 0.592%/year. The average growth rates for output of raw hides and skins were somewhat higher: 0.883%/year in terms of pieces and 0.764%/year in wet salted (w.s.) weight.

Obviously, during this period, the human population has been growing faster than that of bovine animals and it appears that this will remain valid for the future as well: the forecasts of the average growth rates for the time span 2000-2030 are 0.908%/year for the human population and 0.542% per year for cattle livestock.

Major factors affecting the future output of hide and skins include changes in global living standards, meat eating patterns,

¹According to UN classification, the identification of LDCs is currently based on three criteria: per capita Gross National Income, GNI (under USD 992), Human Assets Index, HAI (% of population undernourished, children mortality, education, literacy rate) and Economic Vulnerability Index, EVI (population size, remoteness, merchandise export concentration, instability of agricultural production etc.)

TABLE I
Comparisons of average growth rates 1985 - 2010 (25 years).

	Avg. growth, % / year
Human population	1.41
Bovine	
Heads, <i>million</i>	0.592
Production of raw hides, <i>million pieces</i>	0.883
Production, w.s. weight, <i>thousand tons</i>	0.764
Sheep	
Heads, <i>million</i>	- 0.18
Production of raw skins, <i>million pieces</i>	0.76
Production, dry weight, <i>thousand tones</i>	0.189
Goat	
Heads, <i>million</i>	2.40
Production of raw skins, <i>million pieces</i>	3.37
Production, dry weight, <i>thousand tones</i>	3.35

*Derived from FAO Compendiums 2003/2013 data;
figures rounded up.*

environmental pressures, the potential of Africa etc. The complexity of relationships between these parameters makes it very hard to make reliable long-term projections. Nonetheless, it seems that there will be substantial livestock resources to support a strong tanning sector. The figures also point towards potential needs (not necessarily demand) for leather outstripping raw material supplies.

WHAT IS THE ENVIRONMENTAL IMPACT OF TANNING OPERATIONS? IS IT WORTH INTERNATIONAL ASSISTANCE?

Remembering the principle that *Pollution needs no passport, no visa, created anywhere it can affect anybody elsewhere* let us consider the most visible, liquid emissions.

1. Hides and Skins Processed and Waste Water Produced Globally

Approximate weight of hides and skins process per year:
10 million tons w.s. weight

Approximate discharge at 300 workdays a year:
1.2 million m³ effluent/day

2. Consumption of Chemicals

2.1. Salt for Curing

Computing at the level of 40% of fresh hides & skins weight it makes some **4.0 million tons/year**; after allowing for hides processed unsalted it could be estimated that some **3.0 million tons of common salt per year is discharged into water recipients.**

TABLE II
Estimated water consumption – effluent discharge, 2011.

	Quantity processed per year	Water consumption	Water consumption million m ³ /year
Bovine hides and skins	6.4 million tons w.s weight	30 m ³ /t	≈ 190
Sheep skins	526.0 million pieces (1.0 million tons w.s weight)	200 l/skin → 0.2 m ³ /skin	≈ 110
Goat skins	0.94 million tons w.s weight	30 m ³ /t	≈ 30
Pig skins	1.0 million tons w.s weight	30 m ³ /t	≈ 30
Total*	~ 10 million tons w.s. weight		≈ 360

Based on FAO 2011 data and own estimates

**Rounded up on account of camels, kangaroos, reptiles, etc.*

2.2. Process Chemicals

10 million tons of w.s. weight at 450 kg chemicals/ton gives 4.5 million tons of chemicals added.

A simple mass balance shows that without reuse, out of 450 kg process chemicals/ton added only some 70 kg/ton is retained in leather and 380 kg end up as pollution load; **thus, about 3.8 million tons of chemicals are discharged.**

2.3. Chemicals for Reprocessing

Some often-overlooked pollution emanates from reprocessing/refinishing of batches not meeting the specification; according to some estimates in many tanneries actual consumption of chemicals exceeds the theoretical, recipe-based computation by at least 5%, corresponding to some **0.2 million tons.**

In conclusion, some **seven million** (3.0+3.8 + 0.2) **tons of chemicals per year are discharged from the process**, representing a correspondingly high BOD, COD, SS, nitrogen, TDS etc. pollution load mostly requiring end-of-pipe treatment!

Approximate Full Chemical Mass Balance from Preservation to Finishing:

Salting (cca 40% of the hide fresh weight) + resalting (during longer storage up to 10%) + chemicals in leather processing,

including reprocessing (cca 45% on w.s. weight) \approx 90% of fresh hide weight. The ratio **chemicals used vs. fresh hide/skin weight is \approx 0.9:1.0**

After adding the amount of chemicals typically used for purification of tannery effluents (coagulation, flocculation, sludge conditioning) it can be safely said that the actual ratio **chemicals used to fresh hide weight is \approx 1 : 1.**

3. Pollution Load

These figures alone, i.e. without solid wastes (lime fleshings, shavings, unusable splits, buffing dust, trimmings etc.) and air emissions demonstrate the global relevance of pollutants generated by the tanning industry.

This could be also seen from a different angle. A daily BOD load from a tannery processing 10 tonnes of w.s. hides/day is approximately 900 kg. Computing with population equivalent or unit per capita loading, (PE) of 54 g we receive:

$$PE = \frac{BOD\text{load from industry} \left[\frac{\text{kg}}{\text{day}} \right]}{0.054 \left[\frac{\text{kg}}{\text{inhab.day}} \right]} \rightarrow PE = \frac{900 \left[\frac{\text{kg}}{\text{day}} \right]}{0.054 \left[\frac{\text{kg}}{\text{inhab.day}} \right]} \approx 17000$$

TABLE III

Estimated total global pollution load for input of 10 million tons w.s. weight per year.

Parameter	Typical pollution load, conventional process <i>kg/ton of w. s. hide</i>	Approximate global discharge <i>Thousands of tons/year</i>
Biochemical oxygen demand, BOD ₅	90	900
Chemical oxygen demand, COD	180	1800
Suspended solids, SS	90	900
Chromium, Cr ³⁺	7	*56
Sulfides, S ²⁻	7.5	75
Total Kjeldahl Nitrogen (TKN)	12.5	125
Chlorides, Cl ⁻	225	2250
Sulfates, SO ₄ ²⁻	63	630
Oil and grease	6	60
**TDS	450	4500

*After allowing 20% for chrome-free tannages

**Mainly chlorides and sulfates

It means that the daily BOD load of a middle scale tannery is equivalent to that of a town of some 17000 inhabitants; on the same basis and calculating with 300 working days/year the daily BOD load of the world tanning industry corresponds to that of some 55 million people.

THE GENERAL SET UP OF UNIDO PROJECTS OF TECHNICAL ASSISTANCE (TA) TO THE TANNING SECTOR

This paper deals with UNIDO activities in the tanning sector only; they fall under Program Development and Technical Cooperation Division, PTC, Agri-business Development Branch.

In a typical project of TA the participants (“*stakeholders*”) are the donor country, UNIDO (acting primarily through the Project Manager) all *counterparts* from the developing country - Government administration (Ministry/Agency, local authorities) and actual recipients/beneficiaries of TA, i.e. members of tanners association(s) and/or a leather development center and its users (*direct counterparts and beneficiaries*). A well-composed team of *international and local consultants* and *service providers* is certainly one of the key ingredients too.

In addition to external funds, every project of TA involves significant local inputs in various forms: construction works, some equipment costs, local staff (including their salaries), operational costs etc. In practice, to obtain international assistance Government authorities often promise inputs, which in reality are not readily available; too often local financial support ends upon project completion.

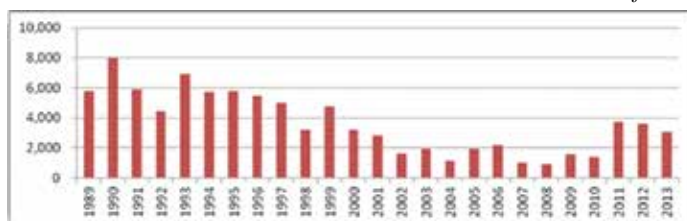
It takes considerable skills and experience to implement efficiently a project involving so many parties of not only very different cultures and outlooks but also with quite different legitimate and sometimes vested interests. For example, the staff from R&D institutions want to visit similar centers elsewhere, Government bureaucrats want to be part of study tours too, whereas the tanners are likely to favor as much hardware as possible. Very often there are unrealistic expectations of the realistic scope and impact of cleaner technologies or readily available solutions for sludge utilization and/or disposal.

In its early years, UNIDO TA was very much orientated towards establishment of leather development centers for training, process and quality control activities followed by environmental issues. The first UNIDO study on pollution control in the tanning industry was prepared in October 1975, i.e. long before the *big shift*, the relocation of the substantial part of the tanning and downstream industry from North to the South. Altogether, it is estimated that in the last 30 years UNIDO was in some way involved in tackling up to 20% of tannery effluent generated in developing countries, in general concept, design, detailed design, establishment or upgrading;

its particular experience is in dealing with Common Effluent Treatment Plants (CETPs) servicing new or old tannery clusters. In some countries/regions local experts and service providers trained under UNIDO projects nowadays provide support to industry to deal with environmental challenges.

Whether explicitly stipulated or not as project aims, well implemented technical cooperation is not limited to technology transfer; it inherently includes promotion of good management, financial discipline, occupational safety and health at work place (OSH), appropriate gender standards and attitude towards child labor, corporate social responsibility (CSR), respect for and acceptance of different cultures etc. All this is miles away or rather ahead of conventional consulting services.

Thousands of USD



The figures for the first few years in the diagram include assistance to the shoe manufacturing sector. In the last few years, it is almost entirely to the tanning sector during which the number of staff in the Leather Unit was reduced.

Figure 6. The value of projects of technical cooperation to the leather sector 1989 – 2013.

TRAINING ACTIVITIES

While UNIDO is not an educational institution, supplementary training and capacity building tailored to specific needs of local counterparts of different backgrounds is an essential part of technology transfer. Thus, training in the key components of leather manufacture such as cleaner technologies, treatment of tannery emissions (including legislative aspects), solid wastes (by-products, sludges) and OSH are regular features of every project, the scope and level depending on primary aims and defined outputs. The typical training and capacity building forms are:

- Lectures combined with practical, shop-floor/hands on work, for example industrial scale demonstration of hair-save liming, chrome recycling or various aeration or sludge dewatering methods
- National, regional and international workshops and seminars, with visits to industrial and pilot and demonstration plants
- Fellowship training with partner institutions (well established training or R&D)

- Participation in fairs, exhibitions, congresses
- Enhancement of local training institutions, including training of trainers
- Preparation and distribution of publications and technical papers, videos, CDs, posters, leaflets, manuals etc., some of them translated into local vernaculars

It is certainly an exaggeration to claim that with modern means of communications technology is only as far away as your computer mouse and Google. However, they offer fundamentally new possibilities of learning, especially for the young, “click & slide” generations. Accordingly, in 2011 the “Animated Visual Training Tool (AVTT)” was launched to supplement the booklet *Introduction to the treatment of tannery effluents*. Five modules of AVTT have been made available for wider public use and are already recognized and accepted as a useful tool incorporated into training by several organizations and institutions. Figures 7 & 8 are examples of processes shown using AVTT.²

In line with recommendations of its Leather Panel in 2012, UNIDO is enhancing existing training materials into full-fledged animated e-Learning materials, including tests.³

Coagulation and flocculation as well as sludge conditioning before dewatering, crucial steps in wastewater treatment of

today, would be impossible without the pioneering work on colloids by JA Wilson; it is a great pleasure and honor to recall his invaluable contribution in this field.

CLEANER TECHNOLOGIES AND UNREALISTIC EXPECTATIONS BY DONORS AND RECIPIENTS

A stumbling feature of many projects from inception, in-house project document appraisal to funding negotiations, implementation and evaluation was the (mis)perception that good pollution prevention i.e. advanced cleaner technologies, can make the end-of-pipe treatment if not entirely superfluous then limited to some simple and cheap procedures such as lagooning with or without forced aeration. Reference to the actual impact of applying all proven cleaner processing methods on pollution load in effluents too often failed to influence such views. Similarly, the fact that nobody, including UNIDO, can offer a readily usable simple and cheap solution for sludge utilization and/or disposal was often met with disbelief.

Of more or less the same rank was the widely spread admiration of chrome-free leather; arguments that chrome related risks are exaggerated and that chrome tanning is more environmentally friendly than chrome-free processes were typically *a priori* brushed-off. To make it worse, any defense of chromium was easily undermined by references to selected

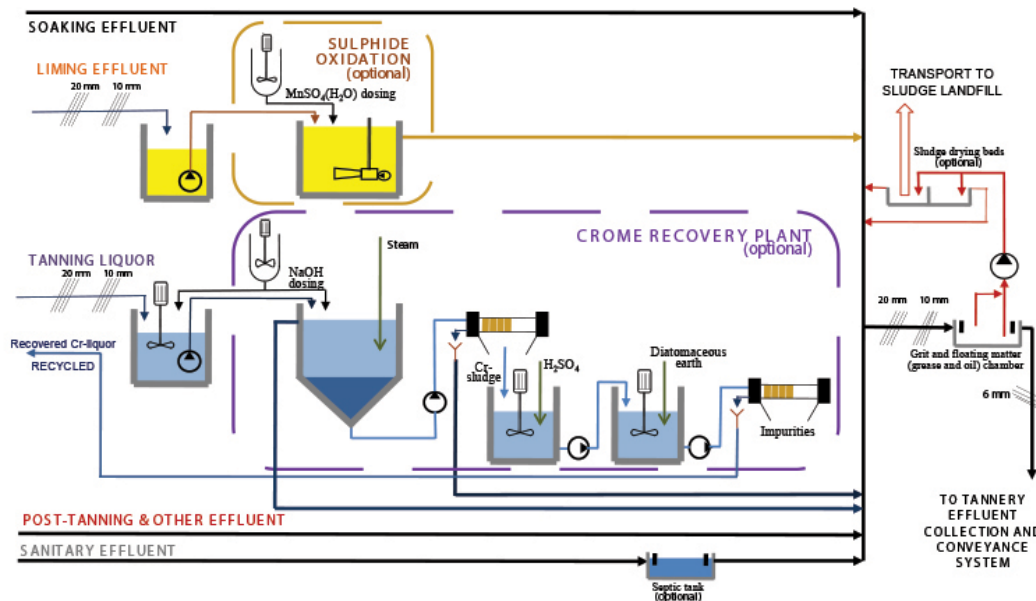


Figure 7. Schematic flow-chart of the in-house segregation of streams, Cr recycling, treatment of liming effluents and on-site pre-treatment of mixed effluent in individual tanneries. The chart by M. Bosnić, animation by F. Schmel.

²For animated version please contact I. Kral@unido.org.

³UNIDO eLearning material on pattern making in footwear manufacture is already at operational stage.

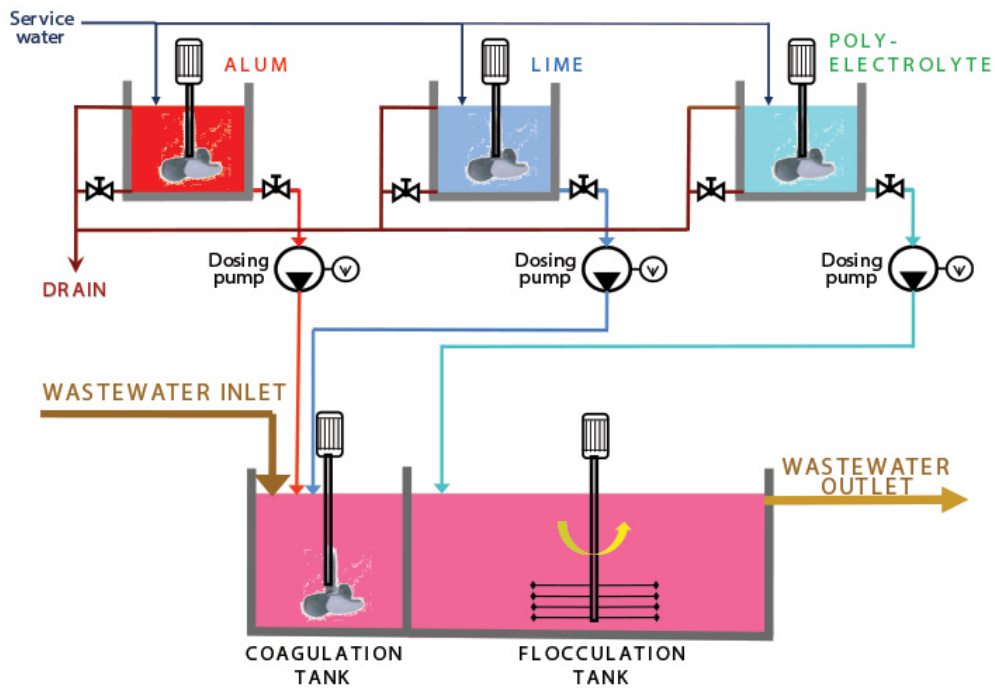


Figure 8. Schematic view of the coagulation and flocculation system. The chart by M. Bosnić, animation by F. Schmel.

articles in some leather magazines and/or quotations from inadequately formulated research papers that in essence disqualified chrome tanned leathers.

Finally, quite often some recipients of technical assistance were surprised to learn that UNIDO projects did not necessarily promote the most advanced, state-of-art technologies (let alone those at laboratory or purely experimental scale); instead, appropriate methods, tuned to specific local conditions were preferred. However, primarily when it comes to treatment of wastes, some methods not widely used at the industrial scale in the tanning industry, such as reed beds or sludge composting, were tested at the pilot level.

SOME EXAMPLES OF UNIDO PROJECTS OF TA

- In close cooperation with SENAI, in the early 1980s a Pilot and demonstration plant was set up adjacent to the Tanning School at Estancia Velha near Novo Hamburgo, Brazil. In addition to the usual physical-chemical

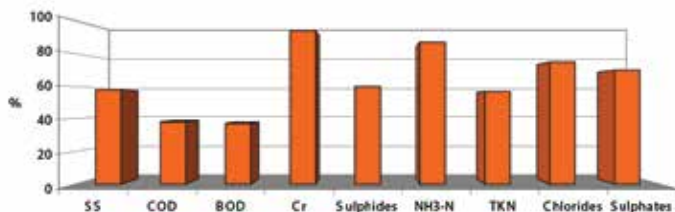


Figure 9. Decrease of pollution loads in wastewater after introducing advanced technologies, %.

treatment it also had several types of biological treatment (the oxidation ditch, aerated/facultative lagoons, a trickling filter etc.) that could be run in parallel, all ending in one of the two sedimentation tanks and sludge line (thickener, drying beds, frame filter press). Subsequently ultra filtration and flotation units were also added.

Sulfide oxidation and chrome recovery were integral parts of the treatment monitored by a specialized lab. Training of environmental enforcement officials were important features of this project with considerable impact. This included “Open Week” in 1983, the Latin American seminar on pollution control in 1987, with participation of eminent cleaner technologies, and treatment specialists, wide ranging extension services to individual tanneries by highly competent staff.

- In the 1990s an integrated program in South-East Asia covering Bangladesh, China, India, Indonesia, Nepal but involving Pakistan, Philippines, Sri Lanka, Thailand and Vietnam too, addressed a wide range of issues

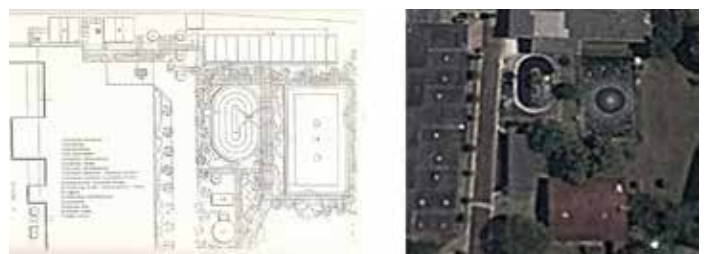


Figure 10. Design and aerial view (Google Earth 2013) of the pilot plant at the Tanning School, Estancia Velha, Rio Grande do Sul, Brazil.

in the tanning industry. These issues included cleaner technology – pollution prevention (optimization, water saving measures, chrome management), occupational safety and health at the work place, gender equality, design and implementation or upgrading of individual and common effluent treatment plants for tannery clusters, utilization and/or safe disposal of solid waste (biomethanation, composting) extensive training of different A lot of useful papers, including manuals on OSH and H₂S were developed and some translated into local vernaculars. Here are some selected components:

- Density of population and land scarcity were quite a challenge at a tanning zone established about one century ago some 20 km from of Chennai India but eventually swallowed by the expanding city. It was necessary to set up an intricate effluent collection and discharge network with a total length of 23 km and seven pumping stations to service a Common Effluent treatment Plant (CETP) treating about 3000 m³/day. Ejectors in the homogenization tank, bottom membrane diffusers in the biological tank together with a belt press for sludge dewatering were quite innovative at that time. Another innovation was that the local tanners association formed a special company to run the plant and to ensure orderly recovery of operational costs from individual tanners and repayment of loans taken to supplement grants given by the state and federal government.
- Several compact chrome recovery units (CRU) using MgO were installed in various clusters, and widely replicated in the region and even in an African country. A technical manual for this simple and yet effective system was prepared and widely distributed.
- Under a rather similar CETP project in the same region construction and operation of a low-cost type of landfill for tannery sludges was demonstrated for the first time. Biological treatment with reed beds was also tested.
- The treated effluent from the nearby CETP with TDS <4500 mg/l and chlorides of <900 mg/l was used for irrigation of selected varieties of inedible plants on a degraded plot of land of about 3.5 ha. Growth of plants, soil and ground water were monitored regularly. Ultimately, the barren land was converted into a mini-forest that attracted insects and birds and now is a showpiece for visitors, practically a pleasant picnic place. This component was implemented by a women only team in 1999 Ranipet, India.

- Ambitious local plans for evaporation of saline streams in solar pans, including UNIDO supported attempts with accelerated evaporation systems failed, and manual and mechanical desalting prior to processing were of rather limited impact. Consequently, in Tamil Nadu, the state with large tanning capacities but serious water shortage other options for saline effluents had to be considered. Reverse osmosis is a well established desalination method but had not previously been applied to tannery effluents. A semi-industrial scale pilot and demonstration RO unit with capacity of 1 m³/h was installed adjacent to ETP to evaluate the technical viability of that technology and obtain the main operational parameters for possible upscaling. After about 9 months of operations and wrestling with many snags it was established that RO was able to reduce TDS from about 5,000mg/l to less than 1,000 mg/l and chlorides even below 500 mg/land thus make the effluent fit for reuse in the tannery instead of bringing fresh water from long distances. The rate of recovery was about 75%, the average energy consumption was 115 kWh/day for 24-hour operations, the cost of RO treatment was US \$ 0.76/ m³ albeit without investment and depreciation costs and without the cost of multistage evaporation of reject. The conclusion of the project team at that time was that sophistication and sensitivity of the system together with extremely high cost of both RO and multistage evaporation of reject did not make it a viable proposition.

However, the local environmental agency subsequently introduced RO as mandatory and reportedly, eight Zero Liquid Discharge (ZLD) systems are now operational in the state. It seems that prevailing factors were water scarcity and the fact that although fully treated, discharged effluent remains unfit for livestock watering and even damages agricultural fields.

- In Nairobi, Kenya within Kenya Industrial Research and Development Institute (KIRDI) a Leather Service Center (LSC) with a full-fledged tannery pilot plant was set up. In addition to training, demonstrations, testing and applied



Figure 11. Reverse Osmosis (RO) pilot plant.

research it serves as a common facility center: small scale, artisanal tanners bring their hides for splitting, shaving etc. A mini-primary effluent treatment unit was also installed.

- In the same country, in a medium scale tannery, a proper segregation of waste streams together with physical-chemical and basic biological treatment was set up at industrial scale for demonstration purposes.
- In a West-African country, an LSC was upgraded and highly qualified staff was trained locally and abroad to support the expanding tanning industry, which was largely dependent on foreign technicians. Tragically, the leading leather experts were killed and the LSC suffered extensive damage during communal violence.
- In the 1990s a large cluster of traditional tanners following nearly Middle Age technologies were keen to produce some finished leather; many of those involved had neither seen a modern tannery nor finishing equipment in operation. UNIDO helped with planning of a Common Finishing Centre, CFC, provided the key equipment and combination of basic theoretical and practical training of staff while the local authorities and tanners took care of construction and utilities. Tanners brought their crust for finishing but more importantly they familiarized themselves with modern finishing methods, including equipment operation and maintenance. Within a few years finishing departments became standard features in all larger factories while CFC still services smaller units against charges introduced from the very beginning to ensure sustainability.
- In a North-African country, the government authorities sought help to upgrade and improve operations of traditional, artisanal tanneries squeezed into the congested space in the heart of the old city. The UNIDO advice was that on hygienic and health protection grounds the tanning activities be moved as soon as possible to a dedicated industrial zone and one clean and orderly tannery with many interesting manual operation be retained as a cultural monument and tourist attraction. Alas, this advice was flatly rejected.
- In the mid-1990s a UNIDO initiative on global ecolabelling envisaged, in cooperation with IULTCS and ICT, to promote leather as a sustainable natural product manufactured with the highest regard for environmental protection verified by a simple and efficient independent international mechanism. The initiative received a lot of verbal support but not a penny of funding. Instead, all over the world, a number of individual (money making?) ecolabel attempts were launched but without major success. Some consolation: The ongoing environmental

assessment/auditing activities carried out by the LWG contain (inadvertently?) many features of the failed UNIDO initiative.

- Under a recent project in an LDC country in South-East Asia, possibly for the first time in this region, hair-save liming has been introduced on an industrial scale. A conventional, existing drum was modified to serve as a pilot demonstration unit for other tanners too. In the same country, a solar water heating system (SWHS) was also installed on the tannery roof and another tannery already followed suit on its own. It is hoped that these technologies will be used in the new dedicated industrial zone to which the existing cluster should be relocated.
- UNIDO is traditionally a significant contributor to IULTCS/IUE documents and reference source for EU Best Available Technology (BREF) norms.

A good insight into UNIDO leather projects can be gained by visiting www.leatherpanel.org.

UNIDO LEATHER AND LEATHER PRODUCTS INDUSTRY PANEL

This global forum service body is a unique mixture of some 20 reputable specialists in leather processing (tanning), footwear and other leather products manufacturing, equipment suppliers, distribution (trading), related pollution control, quality testing and training institutions working in private companies, Government agencies and trade associations, various types of institutions and trade press.

Its primary function is exchange of views and to review and identify the relevant topics and priority issues to be addressed by UNIDO TA. Several studies produced for, discussed in, or as a follow-up of Panel meetings have been used as tools for the project implementation or as reference materials worldwide. Here is a selection of them dealing exclusively or mainly with the tanning sector:

World-wide Study of the Leather and Leather Products Industry (1977/79), Means of achieving improvements in environmental standards in the tanning industry: Environmental assessment and management (1979), *B. Lunden, F. Schmel*: Soft Leather Substitute Materials and their Impact on the International Leather and Leather Products Trade (1984), Estudio techno-económico sobre medidas para mitigar el efecto de la industria del cuero para el medio ambiente, particularmente en los países en desarrollo (1984), Mass balance in leather processing (1997), How to deal with hydrogen sulphide gas (1997), Occupational safety and health aspects of leather manufacture (1999), Sources, detection and avoidance of hexavalent chromium in leather and leather

products (1999), The scope for decreasing pollution load in leather processing (2000), Pollutants in tannery effluents (2000 & 2013), What is the future of chrome tanning? (2000), Eco-labeling in leather based industries (2001), Benchmarking in the tanning industry (2007), Future Trends and Expected Status of World Leather and Leather Products Industry (2010), Introduction to treatment of tannery effluents (2011) etc.

The latest is the Carbon Footprint study for the leather industry prepared for and presented during the 18th LPM in 2012 in Shanghai, one of the very first of its kind that received worldwide attention.

The list of venues of Panel meetings itself is quite telling. The first three sessions were held in *Vienna*, Austria (1978, 1979), followed by *Beijing*, China 1980, then in 1981, 1982, 1983, and 1985 in *Vienna*, Austria, 1987 *Alexandria*, *Egypt*, 1988 *Pécs*, Hungary, 1991 *Madras* (now *Chennai*), India, 1993 *Nairobi*, Kenya, 1995 *Tehran*, Iran, 1997 *Bologna*, Italy, 2000 *Zlin*, Czech Republic, 2005 *León*, Mexico, 2007 *Gramado*, Brazil, 2010 *Addis Ababa*, Ethiopia, 2012 *Shanghai*, China.

The next venue? Why not in the USA?

UNIDO TA TO THE TANNING SECTOR IN NEW CIRCUMSTANCES

Two factors nowadays dramatically influence the scope of UNIDO TA to the tanning sector. Firstly, there has been rapid expansion of the tanning industry, including build up of own technology competence in developing countries, availability & accessibility of information through IT and on the spot support by suppliers of chemicals. Secondly, the low priority assigned within UNIDO to specific assistance to individual industrial sectors together with drying up of funding by traditional donors call for a substantially different *modus operandi*.

As a corollary, adjusting to new circumstances together with lower funding support, UNIDO assistance to the tanning industry remains focused on environmental issues (prevention - cleaner technologies and treatment of wastes) with emphasis on training. Its role is nowadays of a globally present catalyst increasingly acting in the e-World.

Due to inherently complex and interwoven issues of a political, legal, economic, and environmental nature, the relocation of traditional clusters of predominantly tiny units to dedicated industrial zones with appropriate infrastructure, including common effluent treatment plants, normally requires many years. UNIDO's vast experience in that area remains an invaluable asset.

WHAT ARE THE MOST PRESSING ISSUES/ CHALLENGES CONFRONTED BY THE INDUSTRY?

- Total Dissolved Solids, TDS, mainly chlorides and sulfates content in tannery effluents, colloquially salinity, unaffected by wastewater treatment. This issue is of particular importance in arid regions and in the absence of (large) municipal wastewater treatment works (WWW).
- Further reductions in water consumption bringing many benefits including reduced consumption of chemicals
- In that context, Reverse Osmosis (RO), combined with multistage evaporation of the concentrate is most probably not a good solution due to very high energy consumption.
- Green processing in proximity of the source of raw hides seems to be the only long-term alternative, preferably combined with green fleshing. Presently unpopular preservation of skins (as well as of smaller quantities of hides in remote areas) by drying could be reconsidered. This also implies further (re)search for acceptable biocides.
- Prevention of gradual conversion of trivalent (Cr^{3+}) to hexavalent (Cr^{6+}) chrome in finished leather and leather articles; the fact that the genuine health hazard due to presence of tiny amounts of Cr^{6+} is almost negligible hardly stands any chance against misperceptions provided wide publicity.
- Utilization and/or disposal of solid wastes (fleshings, hair, shavings, trimmings, dust etc.).
- The carbon footprint of leather production already knocks at our door; contribution by long transport of salted hides cannot be ignored.
- It is important that the industry greatly reduces its use of fossil fuels. Progress has been made by some tanneries in reducing their total use of energy and a few tanneries are already utilising some renewable energy.
- Intensive global promotion of leather as a natural and absolutely safe product of unique, superior properties.
- Extensive research about the scope of end use/impact of leather products, including biodegradability of leather. Incidentally, it is an amazing (and self-defeating?) paradox that while the industry and eminent scientists argue that chrome tanning is safe, conferences, magazines and journals are inundated with research papers almost frenetically looking for chrome-free methods.

THE FUTURE OF LEATHER – OR – IS LEATHER STILL NEEDED? – MYTHS AND REALITY

This topic, together with the need for good global coordination of branding strategy is rightly receiving increasing attention; the JAW 2012 lecture dealt with it in a detailed and competent manner. Nonetheless, given the importance of the issues involved here are some fresh accents and supplementary, often opposing views and arguments.

- There are already substitutes with properties superior to leather in the former leather monopoly, *comfort*: see the ski boots.
- Younger generations may neither perceive leather as a status symbol nor associate it with luxury; and there are at least one billion of people, who for cultural reasons are not inclined to leather.
- If not tanned, raw hides and skins would not necessarily remain as organic waste; by anaerobic digestion they could be converted into a source of energy by anaerobic digestion.
- The dilemma *hide for leather vs. hide for food* (despite absence of essential amino acids in collagen) might be rather speculative. Despite growing populations, at present the world produces sufficient food; the reason for shortages lie elsewhere (e.g. huge post-harvest losses in developing countries, food wastage in the developed world).
- A kind of futuristic speculation: artificial collagen grown in sheets, even tuned to meet specific requirements. Alternatively, is collagen modified by nanotechnology a more promising venue?
- Very aggressive *greening* campaigns based on false claims and disregard for good science, compounded with excessive legislation and exaggeration of risks of associated with presence of Substances of Very High Concern (SVHC) in the long-run seriously undermine the future of the leather sector.
- If it were not for fashion (a great contributor to high turnover rate), *durability* would be a great advantage of leather made items. In reality, fashion changes shorten the actual usage span of clothing apparel, including footwear, leather goods and garments.
- In the future, *recyclability* and *biodegradability* may be among crucial parameters tipping the balance in favor or against leather vs. substitute materials.

- Leather is a material of unique properties but this needs to be shown, *leather should look like leather*; too often organoleptic assessment is insufficient to establish whether, for example, automotive upholstery is genuine leather or not.
- The cases of fur and to some extent the wool industry can be a warning to tanners. Nowadays in Europe wool is often wasted (not very encouraging for promotion of hair-save liming). Tanners have to part with some self-delusions.
- We are witnessing not only the relocation of leather and leather producing capacities but also of associated industries and activities (chemicals, auxiliaries, shoe components, quality assurance laboratories). Leather R & D institutions in the industrialized world are already becoming insignificant; a few surviving specialized magazines contain more general news and marketing than genuine research and/or analytical articles! Could the relocation of designers' houses to the new large absorbing capacities (read: millions of new buyers every year) in the Southeast be the next step? Of course, for quite sometime, for marketing reasons, the western fashion brands with their old addresses will be retained.
- *Consumerism, short-termism vs. quality and durability*: Is it not about time to consider a paradigm shift, a very different strategy - superior quality and durability, coinciding with the old principle *waste not want not* i.e. towards responsible and rational utilization of resources and sustainable development? Or will a suggestion that the same leather bag or briefcase should be used for several years, a pair of shoes proudly worn for a few seasons in the best case bring nothing but a benign smile...

BY WAY OF CONCLUSION

Bilateral and multilateral cooperation should coexist and synergistically supplement each other in an effort towards improving living standards in poor developing countries for a safer and prosperous world. Otherwise, in the long-term, it is very unlikely that sophisticated technology and advanced security systems will be able to provide an effective shield against manipulated despair of millions born in poverty with no hope for better future. Indeed, as domination and pecking order are part of our nature, mutual support has been essential for survival of humans; while earlier it mainly included the extended family, tribe or nation, now, in the globalized and nuclearized world it encompasses the whole world.



Dietrich Tegtmeyer presents the Wilson Award to Jakov Buljan.

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