



*The dyeing department comprises a mixture of seventeen wooden and tri-compartmental vessels. The two vessels shown are of Chinese manufacture, are newly installed, and process loads of 2.5 tonnes shaved weight respectively.*

# Tannery of the Year: Xuzhou Nanhai, Suining, Jiangsu Province, China

*Owned and operated by industrial group Guangdong Holdings (GDH), Xuzhou Nanhai Tannery and Leather Company is a full service tannery in the northern location of Jiangsu Province. At one time, GDH ran three tanneries in different parts of China, but since 2004 has consolidated all its leather production here.*

A group as diverse as Guangdong Holdings was always likely to consider adding a tannery to its diverse portfolio of operations. Owned by the government of Guangdong Province, it witnessed at close hand the astounding industrialisation of the region around the Pearl River Delta towards the end of last century and had a hand in much of it. Taiwanese and Korean as well as Hong Kong-based companies soon began making shoes for every market in the world in this part of southern China so that, by 1999, there were an estimated 25,000 footwear factories there and the appetite for leather seemed insatiable.

GDH opened its first tannery in Foshan City, near Nanhai, in its

native province in 1993 and had sufficient success, especially after a flotation of its stock on the Hong Kong Stock Exchange in 1996, to branch out and invest in two further facilities much further north. One in Qingdao City and one in Suining County, close to Xuzhou in Jiangsu Province. Both northern outposts incorporated the Nanhai name into their titles to emphasise their links to the original GDH tannery in the south. By 2004, the group took the prophetic step of concentrating its leather production away from Guangdong, several years before the number of footwear factories in the southern province began to decline. It picked Xuzhou Nanhai to become the



sole GDH tannery in 2004, since which time it has already expanded. It has plans for further development of the site it occupies in a special economic development zone of Suining County.

The site at the economic development zone was purpose-built by the tannery in 2007. The original GDH tannery in the area was in a residential zone in Suining (the town had grown up around it at a fast pace) so the company moved to the new site three kilometres away and still carries out beamhouse, dyeing and finishing there. In 2005, it acquired a smaller unit two kilometres from the main tannery, the Gangwei Tannery, and the company uses Gangwei today to give it extra capacity in finishing and drying. It has converted the original building that is now downtown into one of three dormitories for its workers.

Around 90% of the leather Xuzhou Nanhai Tannery and Leather Company produces goes into footwear and the rest into bags and other accessories. Technical director Du Changlu says 55% of the output is being finished in Gangwei at the moment and 45% in the main unit, which also houses the management, commercial and technical support teams for the company. In total, the company employs more than 700 people, more than 400 at the main site and almost 300 at Gangwei. More than 40% of the workers are women.

## Raw material sourcing

Almost 100% of the raw materials that come in are from the US; they arrive as wet salted. Current volumes coming in are around 600,000 hides a year, from which Xuzhou Nanhai is able to make 48 million square-feet of finished leather. "But we are going to build another beamhouse," says Mr Du, "on another piece of land we own here in the economic development zone. We bought that land in 2007. The plan is to increase our capacity to 1.8 million hides per year. We are waiting for the approval of the local authorities in Suining County before we begin construction. It's a five-year development plan, and this is year one. In 2017 the new plant will be fully operational and we'll be making 144 million square-feet of leather every year. We're only waiting for approval; there is no shortage of employees and no shortage of capital. We are turning away orders from our customers at the moment. And we think it's better to become bigger. With environmental requirements



*Nearly 50% of the workforce at Xuzhou Nanhai Tannery are female. They are found in operations throughout the whole tannery, including work that is traditionally associated with male operatives.*

becoming stricter all the time, tanneries that cannot meet them will not do well."

Tanneries that expect to receive approval for expansion plans in China at the moment, he continues, should meet four conditions: they have to operate in keeping with the regulations, they have to have enough capital to run and to invest in up-to-date equipment, they have to respect the environment (this is the most important of the four, he insists), and they have to build up the technical skills of the people who work for them.

## Tannery closures in China

The subject of Pingyang County in Zhejiang Province comes up. In August 2012, the county authorities said beamhouse operations there will not be allowed to continue from the start of 2013, and, by June 2014, all tanning must stop; they want tanneries to start buying leather in from elsewhere and to concentrate on producing finished leathergoods. Pingyang County had an estimated 1,200 tanneries ten years ago. Five years ago, the county authorities reduced the number of tanneries in the area to 57 owing to the industry's environmental performance at the time. Now, even these 57 must stop producing leather.

For Mr Du, the principal reason for this action by the authorities in Pingyang is their doubt about local tanneries' ability to meet the four conditions he lists, especially number three. "More counties will follow this example," he insists. "And it's fair enough for them to do so if operators cannot or will not take care of the environment. It's good news for us, for tanners who do take care of the environment." He adds, however, that there is no reason why medium-sized and smaller tanneries cannot continue to operate, as long as they meet the four conditions. It is not a question of only the biggest being allowed to survive and of the big becoming bigger all the time.

Being state-owned is a help to Xuzhou Nanhai in this regard. The technical director wouldn't have it any other way, but he acknowledges that GDH, whose other interests include an influential investment company and a brewery among a total of 55 operating subsidiaries, has helped the tannery perform at a high level because it takes environmental matters and corporate social responsibility extremely seriously. "Having GDH as our owner means we are not just run to make a profit," he explains. "The company has invested RMB 800 million (about \$125 million) over the last ten years



### From a technical point of view

#### (1) Overview of operations

Xuzhou Nanhai Leather Factory Co. Ltd. is located in Xuzhou City in the Jiangsu Province. The tannery was established on this site in 2007, has a maximum production capacity of 48 million sq.ft/year. The production is from the raw state to the finished state as chrome tanned leather. More than 90% of the leather manufactured is for footwear use with focus on the Chinese market, and up to 10% for leather bag construction.

About 50% of the production is finished at this location, with the balance - mainly non-black production after dyeing/retanning - dried and finished at Xuzhou Gangwei Leather Co. Ltd. This is situated about 3 kilometres from the main site, but both facilities operate as a single unit, known as Guangdong Tannery Ltd. This is the third largest manufacturer of shoe upper leathers in China and employs 400 people.

#### (2) Manufacture and processing

The input mainly comprises fleshed and salted/brined hides from the US, with an average weight of 29kg although some non-fleshed Australian salted hides of similar weight are also being processed at present. No hides of Chinese origin are being used. On arrival the hides are inspected, graded and sorted into five weight ranges.

The soaking and liming/unhairing processes operated in 27 conventional wooden drums that are set in two adjacent buildings. Each drum is 4.5m x 4.0m diameter, and operated with a maximum input weight of 7,000 kg, but this weight can be reduced according to hide conditions. In addition, in a third building there are eight paddles that are used for soaking only, so that more drums can be used for liming hence increase output. These paddles have a volume capacity of 10m<sup>3</sup>, and operate so that a pair of paddles contains the standard input load. All of the water supply to the drums is managed manually with hot and cold water addition to feed hoppers. The drainage arrangements enable segregation of sulfide-containing wastewaters to enable sulfide recovery (*re: Section 4b*).

In general the hides are processed using a one day soak and one day liming/unhairing, but when the hides are non-fleshed, then there is a short soak, followed by fleshing, with the soak continuing to one day.

There are four pairs of fleshing machines within the liming departments, designed to operate in tandem. Palletised hides are delivered to a loading station where they are individually hooked onto a line conveyor, then raised to the first elevated fleshing machine. Here the hides are automatically released and opened for the butt to be fleshed. The hides feed out from this operation onto a chute for delivery to a second machine set at a lower level. The neck section is fed into this machine, and the open fleshed hide delivered to floor level via chute for stacking.

The limed hides are then batch-delivered to the splitting machine where two operatives trim and position the hides.



The input is based on salted/brined USA hides. These are inspected on receipt and sorted into five different weight categories.



These Australian hides have been lifted by forklift onto the loading station for attachment to a conveyor line that feeds the elevated fleshing operation. This arrangement is used on all three pairs of fleshing machines.



This shows the arrangement of the three pairs of fleshing machines. Half of the hide is fleshed on the upper machine, with chute feed to the lower machine to complete the operation. The hides are delivered to floor level, then stacked (onto a pallet set at an angle). The fleshings are delivered into an open container.



Two more operatives slide each hide to the splitting machine, and then together with the two splitting machine operatives all four offer the butt to the splitting machine. Once feed commences, the next hide is slid forward for presentation.

The tanning takes place in a separate building that is fitted with 18 elevated wooden tanning drums each 4m x 3.5m diameter and set in two lines. After weighing the goods, the drums are loaded by forklift truck. All of the water and chemical additions are made manually, and each drum is fitted with peripheral drainage that enables all of the chrome-containing wastewaters to be separated for chrome regeneration (*re: Section 4b*). All of the production is chrome tanned, although wet white leathers have been produced on pilot scale.

Three machines are used for wet blue samm/setting, and are manufactured by the Chinese manufacturer Jinjaioa. This is followed by inspection and grading in a separate department. All leathers that are held at this stage are wrapped in polythene before shaving using three Huzhou-Mercier double width machines and two by Flamar-Italia.

The dyeing department contains two stainless steel tri-compartmental drums of size 2.5m x 2.5m diameter manufactured by Xinjijulong Leather Machine Co. that operates with a shaved input weight of 2.5 tonnes. In addition there are five smaller Italian tri-compartmental drums, and 10 wooden drums at 2.5m x 2.5m diameter that operate with an input of 1.25 tonnes. Since installation, the preference has been to use the large tri-compartmental vessels, so that the wooden drums are not fully utilised.

After dyeing, manufacture either continues to the finished state at this location (*Xuzhou Nanhai Leather Factory Co. Ltd.*), or delivered to the Xuzhou Gangwei Leather Co. Ltd.

Approximately 70% of the production is as whole hides to ensure a more level dyeing, but after dyed samm/setting using Bause throughfeed machines, the hides required as sides are cut. All of the leathers are then delivered to the vacuum drying units where they are sprayed with water, then hand set on the drying plates. A mixture of Cartigliano and Yang Bao vacuum driers is used, and this is followed by airing off on overhead pole drying conveyors. Vibration staking machines are used for softening after spray conditioning, but tumbling drums are also used both pre-finishing and within finish followed by horizontal through-feed toggling.

Considerable use is made of hand operations within the finishing areas. Stucco applications are made to many of the leathers and both the application and removal of the surplus paste are by hand and done by female operatives. This is followed by airing off, then either buffing, light embossing or plating according to requirement.

The first finishing coats are also applied by hand. These machines are made in-house and operate using a continuously moving conveyor; there is one operative feeding the machine, one at off-take, and four operatives hand padding. These operations are followed by spray finishing on conventional throughfeed units.



The major movement of goods within this plant is reliant upon forklift trucks, as shown loading one of the tanning drums.



The shaved wet blue are dyed as whole hides, then, if required, cut into sides after samm/setting. Because of the lower thickness at this stage, three hides are positioned on the beam, then cut into sides as opposed to individual siding as in the pre-split/split state.



Before vacuum drying the pieces are sprayed with water to assist the hand setting operation. This water is continuously collected, screened and recycled back to the operation.



Toggle drying is also employed, and takes place following dry milling both before finishing and within finishing operations.



Many of the operations in finishing are based on hand applications. In this example excess stucco is being removed from the grain of the leather as the first stage in finishing operations.



Another example of hand operations is the first finish coat application. It is considered that this ensures a more individual attention to the needs of each piece and a higher base coat adhesion.

### (3) Solids management

- Raw (*pre-limed*) and limed fleshings are sold for grease extraction.
- Limed flesh splits are sold for manufacture elsewhere into furniture leathers.
- Wet blue shavings and trimmings are sold for leather board manufacture.
- Chrome precipitates are regenerated into a chrome tanning solution (*see Section 4b*).
- The ash from the coal fired steam generation plant is used for building block manufacture.
- Sludges from effluent treatment are disposed as waste. Other uses are limited due to legislation.
- General waste is segregated; all containers are washed and sold for other purposes.
- Pallets are recycled within the plant, but at the end of a useful life are broken and used as fuel for hot water supply.

### (4) Water and environmental management

#### [a] RAW WATER

Water is provided by municipal supply.

#### [b] RECYCLING AND CHEMICAL RECOVERY

**Chrome regeneration and reuse:** All of the chrome-containing wash waters and drainings are separated and after coarse screening held in a collection/balancing tank within the effluent treatment plant. This wastewater is then pumped through a filter press to remove fine solids, and then dosed with a solution of sodium hydroxide in a mixing tank where it is retained for several minutes, before settling in a concrete clarification tank for 12 hours. The settled chromium hydroxide suspension is dewatered using two filter presses to form a cake of approximately 40% solids, with the chrome-free supernatant from clarification and the filtrate from sludge concentration discharged to the effluent treatment plant.

The chrome-cake is added to a sump fitted with a stirrer, and mixed with sulfuric acid for 2 hours to form a chrome solution at pH 2.5. The chrome solution is not considered usable at this stage because of the residual protein content, so a further stage is applied that includes the solution being pumped into a reactor, where the temperature is raised to 95°C by steam injection. This chrome solution is then reused within the tanning process.

**Sulfide recovery and reuse:** All of the sulfide containing liquors are separated, and delivered to a dedicated holding tank within the effluent treatment plant. This wastewater is then pumped into a pair of sealed tanks set in parallel where it is treated using sulfuric acid to lower the pH to 5.0. Compressed air is blown into the base of the tanks to mix the solution and flush hydrogen sulfide that is formed by the reaction from solution. These gases are delivered into the base of two scrubbing columns, where the hydrogen sulfide is dissolved in a spray of sodium hydroxide to form a sodium sulfide in solution. This alkali wash continuously recycles from a reservoir that serves each column. The final mixture of recovered sodium sulfide/sodium hydroxide is reused in the subsequent unhairing/liming processing.



Final inspection and grading at Xuzhou Gangwei Leather Company.



Chrome regeneration and reuse is practised. After precipitation and dewatering the chrome precipitate to 40% moisture, the chromium hydroxide is dissolved in sulfuric acid in the mixing vessel. The solution is then pumped to the elevated reactor vessel where it is steam heated, then chemically treated to remove residual protein from the complex.

This recovery operation works as a batch process of 30 minute duration and the operation is stated as providing 99% sulfide recovery and reuse. The whole effluent treatment plant is free of any sulfide odour.

## [c] EFFLUENT TREATMENT

The wastewaters are segregated at source and maintained as three separate streams: chrome containing, sulfide containing for regeneration/recycling (*Section 4b*) and general effluent. The general stream is treated conventionally, comprising screening, balancing, chemical and biological treatment.

The supernatants from both chrome recovery (*alkali*) and sulfide recovery/solids separation (*acid*) are discharged to this general stream for full treatment, together with the acid supernatant generated from emission scrubbing following coal combustion (*Section 4d*). ©



Hydrogen sulfide is liberated from the used lime/unhair liquors by acidification in the two sealed tanks, and the gas washed into solution in two scrubbing columns. Sodium hydroxide solution is used as the wash medium, and the recovered sulfide is used in subsequent liming/unhairing processing.

in social responsibility. In this county, for example, Suining, we are the only company paying for full insurance for our workers, for health, for retirement, for employment protection and for life assurance. This was our decision, a decision from Xuzhou Nanhai, but we have the reassurance that our bosses, as a state body, are not looking for profit first and foremost."

Originally from Shandong Province, Mr Du is a graduate of the leather chemistry and engineering programme at Sichuan University, where he studied under former president of the International Union of Leather Technologists and Chemists Societies, Professor Shi Bi. He graduated in 1995 and started working at a tannery in Beijing. Two years later, he moved to take a

position at the original Nanhai tannery in Foshan and moved to Xuzhou when GDH concentrated its tanning interests there.

The location is interesting. Xuzhou seems slightly off the beaten track. Jiangsu is a coastal province, but Xuzhou is tucked away in its north-west corner, around 200 kilometres from the nearest port at Lianyungang. Hides that the company buys from the US arrive here and are transported to the tannery by road. The company does business directly with some of the largest hide suppliers in North America and, when necessary, also buys from traders in China. The hides come wet-salted.

Most of the chemicals the company uses in its tanning operations also come from overseas providers, with almost all of the big

European leather chemicals manufacturers on its list of suppliers, alongside a small number of Chinese manufacturers for basic products such as sodium bicarbonate, sulfuric acid and sodium chloride. "They are consistent," says Mr Du of the big western suppliers. "Our results using their chemicals are consistently good. The quality is good and their products are in keeping with our environmental strategy."

On that subject, Xuzhou Nanhai has ongoing input into its environmental policies from one of China's foremost experts in waste management in tanneries, Dr Ding Zhiwen, another of Professor Shi Bi's protégés. Dr Ding has devised his own system for effluent treatment plants (see the technical sections of this report) and Xuzhou



Combustion within the coal fired steam generation plant is very efficient, as demonstrated by the fine ash which is virtually carbon-free.

### [d] ENERGY AND EMISSIONS

Steam is generated on site using a custom built coal fired boiler. This replaces two old boilers where the combustion efficiency was comparatively inefficient, and operates in the following way:

- The coal is of irregular size, and the consumption is greater than 10 tonnes/day.
- The coal is fed by conveyor into a crushing unit where it is reduced to more uniform size of between 0.5 cm and dust.
- This mix is delivered by elevator to overhead hoppers with the sides inclined at approximately 30 degrees to the vertical. This enables free-flow of the coal by gravity to a blower unit set at the hopper base.
- The pulverised coal is blown into the boiler dispersed within the combustion air. The flame produced is more similar to an oil fired system than conventional fixed bed combustion.
- The operation is very efficient, with almost no carbon content in the residual ash.
- All gas emissions are water scrubbed before discharge via chimney to atmosphere. This scrubbing:
  - removes fine solids to minimise smoke and particulate emissions,
  - removes sulfur dioxide, hydrogen chloride, and nitrogen oxides as acid gas emissions.
- The scrubbing waters are continuously discharged to settling tanks and the solids removed from the base by a scraper mechanism.
- The acid supernatant is discharged to the effluent treatment plant where it is added to the general effluent discharge (*sulfide containing liquors are treated separately, so there is no risk of hydrogen sulfide emissions – reference Section 4b.*)

Nanhai is one of a series of forward-thinking tanneries across the land to have put his ideas into practice.

Mr Du has an open mind with regard to where innovation in leather chemicals comes from. He is currently running a trial with a new product called TWT from Chinese manufacturer Tingjiang; it's for chrome-free tanning. Tingjiang has developed the products, which are based on polymer resin, with the University of Sichuan. Mr Du's view so far is that TWT is producing results that are close to those of chrome tanning. He likes chrome and feels that alternatives will find it difficult to emulate the properties of chrome-tanned leather, but acknowledges that there is a trend towards chrome-free at the moment and that new ideas are worth investigating.

When it comes to investing in tanning machinery, he has four criteria. If a machine works, if it helps his tannery produce good leather, he will use it. Second, its energy-use must be "reasonable". Third, the machine must be consistent in the quality of its operation. And after all of these, price comes into the equation. "New machinery can make the quality of our leather better," he says. "Without innovation in machinery and new chemicals, we cannot develop new products. If I have a new idea, I can't make it work without the help of the chemical and machinery suppliers."

Again, European names dominate on the list of machinery suppliers to Xuzhou Nanhai, but one addition in the last few years is a series of tri-compartmental drums from Hebei-based Xinji Julong. The same company supplies milling drums. Asked if investment in machinery from Chinese suppliers represents a false economy, Mr Du says: "The problem is there, but it's not a very serious one. European prices are high for us and these drums are about 50% cheaper. If the difference were less, if the European drums were, say, only 20% or 30% more expensive, we'd buy European drums every time. The Chinese drums work quite well; sometimes the quality is not so far away from European quality, and there are other examples of this in spraying machines in the finishing department, and in staking and toggling machines."

### The way of the world

Managing director, Sun Jun, says hide prices are close to their historic high, while the quality of the material coming into his tannery is the lowest he can remember. "This trend will not change," he says. "The price of raw hides is high, but it will go higher and the price of finished leather is not keeping up. Ten years ago, we were able to secure RMB21 or RMB22 for a square-foot of finished leather. That price has risen by between 20% and 25% over that time so that we can now sell a square-foot of leather for RMB24 or RMB25. But the cost of everything we need to make the leather has more than doubled. Tanners must develop a stronger understanding of economic trends or see their tanneries go bankrupt. At the moment there are 3,300 tanneries in China, but five years from now there will probably be only 2,000 left; there is little profit to be made by tanners today. Many are family-owned and they may not know how to interpret their performance in the context of global economics, how to invest well the money they make. If they cannot learn to do this, they will face crises. This is not just about knowing how to turn a hide into finished leather. Tanners must understand the world better, have knowledge of the meat industry, because slaughter is up to the meat industry alone, and of currency rates. Waiting for the hide price to come back



Opening and loading of hides individually for dyeing from the rear mezzanine in the dyeing department.

down is to leave your future in the lap of the gods. It's better to take control and to find a way of managing with the hide prices as they are. You cannot change the price of hides. All you can do is learn to live with it."

He feels that the best response will be to improve efficiency. He talks about the need for a revolution in attitudes to environmental protection and in technical innovation and, for Mr Sun, this is not just a question of throwing money at challenges as they come along. He insists that some of the expansion projects in the Chinese tanning sector in the last three or four years have flattered to deceive. Tanners have enlarged their production capacity, but putting the expanded capacity to good use has proved to be a different question. "Bosses who enlarged their operations and bought lots of new technology have now ceased production," he says.

The beamhouse at Xuzhou Nanhai works seven days out of seven. "The drums cannot stop," says technical director Du Changlu. Workers in the beamhouse work in three shifts, working basically in the same groups on the same machines. However, when the management feels the entire group has become sufficiently skilled in working at a particular task it moves some of the people around to spread skills and knowledge.

## Growth in prosperity

The tannery aims to improve the lives and wellbeing of its workers, Sun Jun insists. Most obviously, he intends to keep investing earnings back into the business so that the workers will continue to have jobs and continue to enjoy growth in prosperity. He points to a very simple example. Three years ago, there were only six slots in the company car park for tannery employees, now there are 24, but this is still not enough. As salaries have gone up, more of the workers have been able to buy their own cars. "They are very proud of this," Mr Sun says, "and we understand why. So we have made extra parking available to allow people to come to work by car."

Owning a car is all about freedom, as is the desire to travel. Trips to Hong Kong are available as special prizes to Xuzhou Nanhai tannery employees who deliver a consistently excellent performance. Part of this is that the company is keen to hear ideas from the workshop floor. One example of innovative ideas that have made a difference is that the team in the tannery sides by blade after dyeing. At this point, the hides have been shaved to a thickness of two millimetres each, allowing the operators to pile three hides onto the

trestle at once and slice down the middle. As well as the extra efficiency this brings, siding at this stage means a more even dye across the two sides. This idea came from a team of workers and managers and became part of the standard operation only after a six-month trial and close examination of the data it generated.

Executive assistant Chen Fei, a recent graduate in English from Xuzhou University, is in a good position to comment on life in the company's two employee dormitories because she lives in one, the original tannery in what is now downtown Suining. A total of 50 men and women live there and there are single rooms for technicians. Her home village is only 45 minutes away by bus, but others in the dormitory are from much further away, from provinces such as Sichuan, Henan, Hunan and even Guangdong, people, like Mr Du, who worked for GDH down there and moved up to Jiangsu Province with the job.

They have television and much appreciated air conditioning. Summer temperatures can reach 35°C. The winter is dry but very cold, with the thermometer frequently falling to temperatures as low as -10°C. Residents in the dormitory can cook for themselves if they want, but there is a canteen providing three meals a day at exceptionally cheap rates. Rice is free and dishes cost RMB1 for basic vegetable, meat and fish dishes and RMB3 for more special ones. People are free to go out in their free time if they want and there is a good social life. ☺

## Control and accreditation

### LABORATORY SERVICES

**Laboratory services:** standard procedures that are applied in-house are mainly tensile strength and lastometer testing. Chemical testing and environmental analysis is provided by external companies and organisations. All chemicals received by the company are certified to standards.

### AWARDS

- Aokang supplier award
- CLIA Top 100 leather industry brands 2010
- CLIA Top 10 leather enterprise
- Eco-Leather Mark Certificate