Graduation Project

International Fashion Management

Amsterdam Fashion Institute

“Dyes from yesterday, colors for tomorrow”

Kuyichi’s AW-09 collection.

Study Coaches:           Jan Piscaer
                         Rene Spijkerman

Company Coaches:         Margreet van Dijk
                         Bert Bruinink

By Arturo Rojas
Amsterdam – The Netherlands
May - 2008
“Dyes from yesterday, colors for tomorrow”

By Arturo Rojas – IFM
Preface

Through this thesis I wish to present the reader with a systematic structure for sourcing natural dyes. I hope this document will motivate people involved in the fashion industry in order to join efforts in encouraging the industry and the market to produce and apply natural dyes. Out of my experience during this research in Peru, I realize that natural dyes and tinctorial plants can generate employment. Other sources of information point out that there is an abundance of natural sources in non-industrialized countries. Natural dyes will not only add beauty to our clothing and revive the art and skills used in the past, they will also diminish the pollution to our ecosystem. Our combined efforts will probably bring smiles and hope to many families in the third world.
Summary
Summary

The present essay comprises the different phases considered for the execution of my graduation project “dyes from yesterday, colours for tomorrow”

The preliminary phase of this research started in January 2008 during the last month of my exchange program at ESDI, Textile Design School in Barcelona. I read an article about the study of natural dyes found in old Mediterranean textiles. This research was intended to trace back the dye sources and techniques used in ancient textiles. The results of this investigation would enable the fashion industry to count on new sustainable proposals. Dyeing is a technique that has been practiced for centuries. Synthetic colours have replaced the natural ones. However the industry and the consumer are showing an increasing interest in natural and environmentally friendly products.

Kuyichi is a fashion brand that creates style and awareness of the circumstances in the fashion business.

I approached this subject from three different points of view. The first one: a possible subject for my graduation thesis. The second one: a tactical plan and sustainable proposal for a fashion conscious company such as Kuyichi and last but not least, a look into historical facts concerning the study of ancient textiles in Peru and their applications in today’s fashion industry.

I introduced the subject to Kuyichi considering these facts: 1) their fashion conscious mindset 2) Peru as sourcing country for the organic cotton and manufacture, which means an advantage in the supply chain and 3) the name Kuyichi derives from the Peruvian god of the inca’s and means “rainbow” in the ancient Peruvian language, which embodies a potential and marketable selling point for the introduction of natural dyes.

Kuyichi wants to introduce natural dyes in its collections as a tactical plan. Due to aspects related to time and research this plan has not been started yet.
The problem description at Kuyichi is stated as the non-managed opportunity for selling garments with natural
dyes.

The research main question that arose for this thesis was: What is the best way to a successful introduction of
natural dyes in Kuyichi’s AW/09 T-shirts collection?

The aim of this research is setting production-related basis for the development of garments with natural dyes.

The demands of Kuyichi for this program with natural dyes include 1) a “green” t-shirt program 2) a colour
pallet of maximum 4 or 5 different colours and 3) a cost price slightly above of the cost price of garment
pigment dyeing.

The desk research phase, carried out in the Netherlands, comprised the sourcing of Peruvian dye houses. The
field research phase took place in Peru. The tasks included samples development and technical information
gathering. The Dye-houses approached were: Ecotintes, Tintes Naturales Inca and Dye and Finish.

The garments were received and observed. Kuyichi’s sourcing and production team expressed their
satisfaction with the first results of this research. A program of garments with natural dyes may eventually be
included in the collection AW09. The quality tests were carried out at the Amsterdam Fashion Institute. The
results point out that just a few colours comply with the European quality standards (ECLA norm).

The cost of dyeing with natural sources surpasses the price of garment pigment dyeing with 50% and the
production budgets must consider an extra amount (20%) of garments to be delivered in the dye house in
order to prevent a shortage of clothing pieces after the dyeing service. Dyeing with natural sources is not a
standardized process and waste might be higher than 10%.

Natural dyes are not intended to replace the market of synthetic dyes. Natural dyes offer an eco-friendly
alternative to the consumer. The qualitative aspects of natural dyes are being improved in order to participate
competitively in the dye market.
EMBARGO
# Table of contents

Chapter one: Introduction 9
Chapter two: Preliminary research 11
  Background information 12
  Dyestuffs and colour fastness 13
  Dyeing 15
  Natural Dyes 16
  Mordants 18
  Natural dyes and the fashion industry 19
Chapter three: Kuyichi 22
  The assignment 28
Chapter four: Analysis of situation 31
  Problem description 32
Chapter five: Desk research 34
  The suppliers 36
  Dyes in pre-hispanic in the Andean 38
Chapter six: Execution – Field research 40
  Tinctorial natural sources 43
  The dyeing process with vegetable dyes 46
  The Supply Chain and lead-times 51
  Cost Information 52
Chapter seven: Results and evaluations 53
Chapter eight: Conclusions and recommendations 63

References 67
Bibliography 68
Appendices 70
Chapter One
Introduction
Introduction

This graduation project is an investigation into the production and sourcing possibilities for the successful introduction of garments colored with natural dyes. The fashion brand Kuyich participates in this project and may consider the introduction of natural dyes in the collection AW 2009.

This document is divided into eight chapters followed by references and bibliography. The first part presents the reader with a summary of the document. The first chapter concerns the preliminary research. This part shows the reader how the concept started, some background information on natural dyes, trends in the fashion market and industry regarding natural dyes. Information about the company, the assignment and the demands of the study are also included. The second chapter embodies information about the brand Kuyichi and the assignment.

The next chapter is an analysis of the situation at Kuyichi concerning the introduction of natural dyes and the work done so far. The problem description and the aim of the graduation project are also included in this part. The fourth chapter comprises the desk research and the first stage of information gathering to start the investigation. The fifth chapter refers to the field research describing the execution of the planning outlined in the appendix. This investigation is finished with results of the investigation, quality tests and evaluations followed by conclusions and recommendations.
Chapter two

Preliminary Research
Preliminary research

Background information

“The greening of the apparel industry is a significant and evolving trend that is likely to affect every facet of this enormous global industry. Under both internal and external pressure to reduce the environmental impact of growing, processing, treating and dyeing fibers and to eliminate exploitation and inequities in labor practices, textile and apparel companies are eager to show consumers a new, sustainable approach to fashion without sacrificing style or profit”.[1]

The initial research phase for this project started in January 2008 during my exchange semester in Barcelona. A Spanish multidisciplinary project carried out the development of a program that brought together different disciplines: the study of historic fabrics and the latest technological developments combined in a search for results that can be applied in today’s dyeing industry.

The collaboration between the Spanish Association of the Textile Printing, Dyeing and Finishing Industries (FNAETT), the Technological Center (LEITAT), and the Textile Museum and Documentation Centre of Terrasa (CDMT) has culminated in a project that aims to analyse the dyes and dyeing systems used in historic fabrics from the Mediterranean area and to apply the results obtained to search for new sustainable industrial proposals.

Similar studies have been carried out thanks to the association of Peruvian researcher N. Rosario Chirinos to the laboratory of the Royal Institute of Cultural Heritage in Brussels and Jan Wouters, Ph.D.in chemistry with a specialty in biochemistry from the State University of Gent, Belgium. This collaboration aimed to analyse textiles belonging to various pre-Columbian civilizations as well as a series of present-day Peruvian natural dyes. Therefore, forty-two fabrics were selected from the collections of the Royal Museum of Art and History (Brussels,

Belgium) and the Museo Nacional de Arqueología and Antropología (Lima, Perú). The fabrics belong to different pre-Columbian cultures and to the Inca period, covering the era from 300 B.C. to 1532 A.D. The textile pieces were attributed to given cultural periods before any dye analysis was carried out.

**Dyestuffs, Colour Fastness**

The desire to colour textiles is as old as spinning and weaving. Natural colouring materials have been used for thousands of years; mineral pigments such as yellow and red ochre, cinnabar, vegetable dyes such as indigo, litmus, logwood, madder, saffron; animal dyes such as cochineal, Tyrian purple. Synthetic dyes were first produced in the 19th century and have now almost completely replaced the natural colours. Environmental and product safety aspects are currently very important.

With the exception of pigment/binder systems the type of dyestuff has to be chosen to suit the fibre substrate, because the formation of a physical or chemical bond between dye and fibre depends on the chemical and physical structures of both dye and fibre. A broad spectrum of colours is available in countless shades and wide range of fastness for the different fibre types and blends.

**Colour fastness**

Colour fastness means the resistance of the colour to the various insults which textiles may suffer during manufacture and use. Fastness depends on the type of dyestuff and the fibre substrate; there is no universal colour with the same fastness on all substrates. Moreover, different end uses have different fastness requirements; underwear has different requirements from furnishings.

There are standardised methods (ISO 105) of evaluating the different types of fastness. The most important are:

**Rubbing:** Resistance of the colour to rubbing, either wet or dry. Even the best dyeings, in a very deep shade, may lose some colour in wet rubbing.
**Washing**: The fastness to washing determines the wash program which must be used by the consumer. Nowadays, fastness to a strong wash at 60°C is expected.

**Perspiration**: Resistance to the effects of perspiration is important for underwear, outerwear, and sportswear.

Colours may also be required to be fast to light, weather, seawater, solvents, ironing, etc.

**Dyeestuffs in relation to the fibre substrate**

<table>
<thead>
<tr>
<th>Dyestuff</th>
<th>Substrate</th>
<th>Method</th>
<th>Fastness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>Cotton, linen, viscose, silk</td>
<td>Simple diffusion into the fibre, from aqueous solution</td>
<td>Relatively poor fastness to light, washing and perspiration. Can be improved by aftertreatment</td>
</tr>
<tr>
<td>Reactive</td>
<td>Cotton, linen, viscose, wool, silk</td>
<td>The dyestuff forms a chemical link with the fibre.</td>
<td>Very good fastness properties</td>
</tr>
<tr>
<td>Vat</td>
<td>Cotton, linen, viscose</td>
<td>The insoluble dyestuff is made soluble in a reducing vat so that it can diffuse into the fibre. After diffusion is complete, it is then re-oxidised into its insoluble form</td>
<td>High fastness to washing, chlorine, boiling, light, weather, rubbing and perspiration.</td>
</tr>
</tbody>
</table>
Dyeing

Textile materials are dyed in aqueous solutions or dispersions of dyestuffs, together with dyebath additives such as salt, alkali, acids and other auxiliary chemicals. The dissolved or dispersed dyestuff must first be absorbed onto the fibre surface and then diffuse into its interior.

Dyeing Machinery and Processes

The choice of dyeing equipment depends on the type of fabric (woven, knitted, nonwoven), and the fibres it contains. Polyester fibres often have to be dyed at temperatures over 100 °C and so machines which can operate under pressure must be used.

The dyeing process may be continuous, discontinuous (batch), or semi-continuous.

**Batch dyeing process**

In a batch process, a defined weight of fabric is treated in a self-contained machine, in a bath, which contains a defined weight of dyestuff. Fixation of the dyestuff may be in the same machine or in a separate process.

**Continuous dyeing**

In continuous or pad dyeing the open-width fabric is passed through a relatively small pad bath, containing the dyestuff and auxiliaries, and is then squeezed between rubber-covered rollers. The squeeze rollers ensure that a defined quantity of the liquid is uniformly penetrated and distributed within

---

and across the fabric. After the padding station there will be some form of continuous dye fixation machinery, depending on the fibre and the dyestuff type. The pad mangle is a component of all continuous processes, whenever there is a requirement to handle fabric in the open width and to apply a dyebath or other concentrated chemical liquor in a uniform manner.

**Semi-continuous Dyeing**

The dyebath is applied to the fabric on a pad mangle and the impregnated fabric is wound up onto a batching roller which can hold a very long length. Fixation of the dyestuff can be carried out on the batching roller, which may be slowly rotated at a docking station for several hours at a certain temperature, or the batch may be taken and used as the feed for a separate fixation process.

**Natural Dyes**

Historically, natural dyes were used to color clothing or other textiles, and by the mid-1800’s chemists began producing synthetic substitutes for them. By the early part of this century only a small percentage of textile dyes were extracted from plants. Lately there has been increasing interest in natural dyes, as the public becomes aware of ecological and environmental problems related to the use of synthetic dyes. Use of natural dyes cuts down significantly on the amount of toxic effluent resulting from the synthetic dye process.

Today, dyeing is a complex, specialised science. Nearly all dyestuffs are now produced from synthetic compounds. This means that costs have been greatly reduced and certain application and wear characteristics have been greatly enhanced. But many practitioners of the craft of natural dyeing, maintain that natural dyes have a superior aesthetic quality which is much more pleasing to the eye. On the other hand, many commercial practitioners feel that natural dyes are non-viable on grounds of both quality and economics.
In developing countries with a textile tradition, natural dyeing is now practised only as a handcraft. Synthetic dyes are being used in all commercial applications. Some craft spinners, weavers and knitters use natural dyes as a particular feature of their work.

In many of the world’s developing countries, however, natural dyes can offer not only a rich and varied source of dyestuff, but also the possibility of an income through sustainable harvest and sale of these dye plants. Many dyes are available from tree waste or can be easily grown in market gardens. In areas where synthetic dyes, mordants (fixatives) and other additives are imported and therefore relatively expensive, natural dyes can offer an attractive alternative.

**Differences between natural and synthetic dyes**

<table>
<thead>
<tr>
<th>NATURAL DYES</th>
<th>SYNTHETIC DYES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>• use of renewable resources</td>
<td>• standardized and simple technics for usage</td>
</tr>
<tr>
<td>• lack of toxicity during production and reduction of work hazard</td>
<td>• good colour fastness</td>
</tr>
<tr>
<td>• full biodegradation and reduction of the environmental impact</td>
<td>• a wide colour spectrum including bright and fluorescent colours can be achieved</td>
</tr>
<tr>
<td>• lack of toxicity of the end products</td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td></td>
<td>• consumption of non-renewable resources such as oil and by-products</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>• work hazard during production</td>
</tr>
<tr>
<td>• insufficient reproduction</td>
<td>• high environmental impact during production and waste disposal</td>
</tr>
<tr>
<td>• low to medium colour fastness</td>
<td>• danger of allergies (dermatitis by contact) for the consumers</td>
</tr>
<tr>
<td>• limited color shades due to the restriction in the use of mordants.</td>
<td></td>
</tr>
</tbody>
</table>
Nevertheless, responsible synthetic dye manufacturers have worked hard to provide environmentally friendly synthetic dyes. These dyestuffs have undergone rigorous and expensive testing programs and are environmentally responsible.

**Mordants**

Natural dyes generally require a mordant, such as metallic salts of aluminum, iron, chromium, copper and others, in order to ensure the reasonable fastness of the color to sunlight and washing. Customers who have become accustomed to the dazzling colors and wash and light fastness of synthetic dyes are hard to convince, as only a few of the natural dyes have good all round fastness.

**Dyeing waste water**

Toxic chemicals from dyes create severe environmental disorder. Large amounts of water are used to flush conventional synthetic dyes from garments and then this waste water must be treated to remove the heavy metals and other toxic chemicals before it can be returned to water systems, sewers and rivers. At least that is what should happen.\(^3\)

Most garments are produced in developing countries where pollution controls are often nonexistent. Discharges from huge numbers of the textile producers go straight into the rivers where the river water might be bright green one day and yellow the next. Developing countries are also lacking in standards and enforcement concerning the use of toxic chemicals in dyes and garment finishes.

An environmentally friendly alternative for dyes is the low-impact fibre-reactive dyes. Fibre-reactive dyes are a synthetic dye that chemically bonds directly to the clothing fibre molecules. The fixation or absorption rate of low-impact dyes is at least 70%, creating less waste water runoff and therefore a lower impact on the environment.

\(^3\) [http://organicclothing.blogs.com - dyes and chemical sensitivities](http://organicclothing.blogs.com)
Natural dyes are often neither safer nor more ecologically than synthetic dyes. They are less permanent, more difficult to apply, wash out more easily, and often involve the use of highly toxic mordants. However, not all mordants are equally toxic and not all natural dyes require toxic mordants to create light and wash fast color ways.

**Natural dyes and the fashion industry**

**Natural dyes: textile market trend in Europe**

During the last 10 years the push due to an increasing ecological conscience in Europe towards ecological consumptions, has influenced also the industry and the fashion. This has resulted in the existence of several institutes for ecological certification. They do not only certify the product, but also the process through which the goods have been manufactured.

Consequently, several developments lead by European initiatives appeared, aiming at introducing cultivation of tinctorial plants, a constant sourcing of the best species and the quality of dyes.

The textile market trends consider two large traditions: the high-tech and supertechnological and the natural one. Our interest focuses on the natural one. It regards fibre transformation and production of items. The emerging consciousness regarding dyes led to the setting of proposals for “crude items”. However, under the push of the market (coloured items remain having the preference) led to a demand for eco-compatible dyes, and for natural dyes. Colours obtained with vegetable dyes are warm and with particular nuances. Nevertheless they have two problems that are the same of the industry: fastness and reproducibility. On the one hand, it is unthinkable to succeed in obtaining equal values as those of synthetic dyes. On the other the limitation regarding diversity, often the diversity is a value, but this does not mean that natural dyes cannot be produced and be sold in an optimal way.

In the last ten years, the demand for natural dyes and the interests generated by them has been going hand in hand with fashion trends, with recurrent ups and downs. Currently we are living an emerging
phase. The fields of the industry that show more interest on introducing natural dyes are intimate dress, children clothes and interiors, for these segments, nature is very important, being allergic problems among the main reasons to go green.

**Levi’s Co.**

Last year, Levi’s Eco organic treatment was applied to its Red Tab lines—including classic 501s—and its high-end Capital E denim line, as well as potentially other lines in the future. In addition to the use of organic cotton, buttons and zippers are formed from recycled metal and natural dyes color the jeans. External packaging is made from recycled paper using soy-based inks.[4]

**Designer: Kyra Jachode**

Spring/Summer 2009 ready-to-wear women’s forecast will be swept away by the environmentally friendly organic movement and crafty chic. The organic movement is the return to all things natural powered by environmentally conscious consumers. Consisting of chalky washed-out vegetable dyes with a burst of hybrid floral brights; the organic movement combines pastel purples, blues, and green hues with fuchsia

and lemon yellow. Organic cotton, Bamboo, and Soy fibers will be in high demand for the organic movement and will be accompanied with eyelet, embroidered, and burn out effects.  

**Designer: Julie Sinden,**

In fact, the use of “natural” dyes in the production of fabric is gaining popularity, even though the process has been used for centuries. Natural dyes are made from plants, earth clays and even insects, which translates to less harm to the ecosystem.

Another hot trend is the use of vegetable dyes on leather garments, whether it be purses, belts or wallets. Roots recently introduced an eco-leather line of purses and wallets. I own one of their bright, red vegetable-dyed leather purses, which brings me tons of compliments wherever I go. Although personally I can’t tell the difference between a chemical- and vegetable-dyed leather item, the experts insist there is one.  

---


Chapter three
Kuyichi
Kuyichi

Company profile

Kuyichi B.V. was founded in 2001 to introduce organic cotton and fair trade jeans wear. Kuyichi makes jeans and fashion products for men and women aged between 25 and 40. The company develops organic materials, ecological processes and fair trade in coordination with the farmers of Peru who produce Peruvian organic cotton, Kuyichi’s raw materials for its Peruvian supply chain. The farmers themselves have been instrumental in the drive for sustainable management of soils and organic solutions for the struggle against pests and plant diseases. Even better, the farmers are partners in Kuyichi, so they get to speak up and profit share.

Branding

Catchwords for the brand are: strong, sexy and nonchalant. Kuyichi has more than 200 sales outlets in the Netherlands and its products are sold in Belgium, Germany, Sweden, Italy, Greece, the United Kingdom, Ireland, Spain, Austria, Switzerland, Greenland and Chile. Over one third of the cotton used by Kuyichi is organic cotton. Kuyichi developed a new production chain for its organic denims that are being produced in Tunisia using Turkish organic cotton and fabrics. In 2006 Kuyichi transferred part of its T-shirt production from one of the Peruvian suppliers to a new supplier in China.

Mission

Kuyichi’s mission is to be an innovative & global brand that designs, produces and distributes organic fair trade jeans and fashion[7]. Kuyichi showcases its Style Conscious concept to other brands: fair trade can be commercially successful, in respect to style, quality and dignity. [8]

[7] The term fashion in this case is used referring to other garments as t-shirts, sweaters, etc.
Vision

Kuyichi’s vision in fashion is integrated, but not compromised by its aim to stimulate durable economies. It is based on two conscious principles: Kuyichi strives for organic jeans & fashion, put together in a chain of fair trade.

Organisational structure

Tasks are defined, grouped and allocated in the overall context of the company structure. The total activity of the company is divided into departments, sections and functions. Individual tasks are allocated as jobs for individual persons.

The organisation of Kuyichi has a direct line system.

Theoretically, this system has a clear, hierarchical chain of command and responsibility, which is rigidly respected. This is not a very flexible system and can be rather undemocratic. Nevertheless, the lines of communication and authority at Kuyichi are open and everyone gets to speak up.

Kuyichi shows a direct line system structure with few functional levels and few lines of authority.

At the highest level of the organisation, the managing director is responsible for designing the corporative strategies and manages the company’s medium to long-term future.

Three directors represent the second level. They are responsible for the development of the tactical plans that are lined up with the strategies of the company. Their main function is to ensure the efficiency of current operations with regard to costs, quality, productivity, safety, and environmental impact.

The operational managers who are responsible for the execution of the tactical plans form the third layer.
Even though there is a hierarchy line, the communication flows vertically and horizontally in a very dynamic way. Plans are bespoken and decisions are taken with high participation of all the employees.

Around 25 employees form the structure of this small-medium company.
Corporate Culture

Inside Kuyichi's head quarters, the personnel cultivate and stimulate a free spirit. Employees are keen on support and help out each other at any time.
The philosophy of being conscious about creating fashion is also present in the daily habits of Kuyichi’s staff.

Among other initiatives for sustainable living we can observe at Kuyichi’s people attitudes towards an environmentally friendly way of living. Recycling, consuming biological food and drink, planting trees and getting the cars of the employees biodiesel fuelled are some of these habits.

Kuyichi has a family-like corporative culture. Birthdays are all celebrated and Friday’s late afternoons are occasions to be shared enjoying a glass of wine and finger food.

Furthermore there is a collective sense of cooperation and solidarity with the partners in the production chain.

**Corporative Strategy**

Kuyichi follows a strict step-by-step approach to the future, aiming for sustainable growth into a global brand. Kuyichi believes sustainability in fashion should be an expectation and not an exception.

Kuyichi’s success for six years now, has realised a rise of organic farming, improvement of social awareness in their factories and availability in over 650 shops in 13 countries worldwide. Stores offering Kuyichi can be mainly found on the European continent, while Kuyichi steadily moves forward to global availability.

With the MADE-BY partner project and the TRACK& TRACE system, kuyichi moves forward to extend transparency. Transparency creates awareness about manufacturing circumstances and thus stimulates the consumer’s preference for sustainable fashion.

So the corporative strategy follows a growing direction as much in availability (market growth) as in awareness.
The assignment

I introduced the subject to Kuyichi considering these facts: 1) their fashion conscious mindset, 2) Peru as a sourcing country for the organic cotton and manufacture which means an advantage in the supply chain and 3) the name Kuyichi derives from the Peruvian god of the incas and means “rainbow” in the ancient Peruvian language, which embodies a potential and marketable selling point if we make the association with natural colors.

In line with Kuyichi’s legend, one realizes that “natural colours” have been taken away from today’s fashion. This tactical plan “Dyes from yesterday, colours for tomorrow – Kuyichi AW 2009” aims at bringing back today’s natural colours used in the past. The gimmick of this basic program will refer back to ancient natural dyes and dyeing techniques used in pre-Columbian textiles.

The aim of the assignment

The aim of this research is setting production-related foundations for the development of garments with natural dyes. The intention is to introduce this collection in the season AW2009.

The demands

The demands of Kuyichi for this program with natural dyes include:

(a) Finding a sustainable dye-house with production capacity and professional know-how.
(b) Colourfastness to light, washing, perspiration and rubbing should be assured.
(c) The possibility to produce aesthetic and marketable colours. Dark colours as grey, green, blue, brown, purple are the suggestions.
(d) A cost price that is slightly above the cost price of the garment pigment dyes. It should not affect the selling price.
It should be possible to prove that the dye sources are the same used in pre-Columbian textiles.

Shortest supply chain possible.

Technically, it is desirable that this research contributes to the technical development of the industry considering a proper infrastructure (dyeing machinery and processes) for dyeing with natural dyestuffs.

Socially, it is desirable that this research encourages brands to demand natural sources that are environmentally friendly and that help families and communities in the third-world with an income through the cultivation and sell of tinctorial plants. This research stimulates the acknowledgment and respect for the richness of our textile cultural heritage.

Economically and commercially, this research into natural dyes is aimed at reinforcing the awareness of the consumer, more than stimulating turnovers. This tactical plan is part of a strategical planning to enhance brand awareness.

Process steps should be defined and a time-line to carry out the project should be included. Possible pitfalls and special appointments should be stated.

**The SMART principle**

This tactical plan complies with the 5 parameters of the S.M.A.R.T. principle:

*It is specific*, because is based on the sourcing of natural and sustainable dye houses in Peru. The expected result is a research report grounded in production information concerning the introduction of natural dyes in a collection of organic cotton tees and tops dyed with natural sources.

*It is measurable* because aspects as colourfastness, costprice, production capacities, dye sources' authenticity, sustainable production and lead-times are the qualitative and quantitative parameters to measure the results of the research.

*This project is achievable*, because natural dyes’ quality standards and applications are being improved and extend to more segments of the textile industry including fashion.
This project is realistic because natural dyes are already being produced, even though in small quantities, for industrial purposes. Moreover these products are aimed at a market niche that is part of Kuyichi’s market target.

This research is time-based because includes a time-table that considers analysis of situation, planning, action, results and evaluation.

This research is intended to demonstrate the feasibility for introducing successfully natural colours in Kuyichi’s AW2009 collection.
Chapter four
Analysis of Situation
Analysis of situation

Kuyichi’s interest on introducing collections with natural dyes is not a new topic. Over the last months, Kuyichi’s production agents have already been sourcing natural dyes. Kuyichi’s production broker in Peru, Iberoandina, provided the brand with some samples of vegetable dyes sourced by one manufacturer and developed at Dye & Finish S.A.C., a dyehouse in Lima. Prior to this, Kuyichi’s cotton supplier in Peru, Oro Blanco, tested natural indigo dyes on cotton t-shirts.

However, except for some swatches dyed with vegetable dyestuffs and a few samples with natural indigo dyes found at Kuyichi, there are no previous studies done for the company concerning natural dyes.

In spite of this, the initiatives have not been continued and the information requested (samples) have not caused the expected impact at Kuyichi. Therefore these projects have been postponed.

Problem description

The problem can be described as the non-managed opportunity for introducing collections with natural dyes. Herewith the aim is to strengthen Kuyichi’s selling points.

Causes

- The consumer trends by demanding sustainable fashion
- Lack of information
- Lack of time
The Research Main Question

“What is the best way to a successful introduction of natural dyes in Kuyichi’s AW/09 T-shirts collection?”

The research sub questions:

- Is it possible to find a sustainable dye-house in Lima with production capacity and professional know-how?
- What can we expect regarding colour fastness, are they in line with Kuyichi standards?
- What is the variety of colour that can be obtained? Are these colours representative for Kuyichi?
- What are the costs of natural dyes? Are they in line with Kuyichi’s production cost’s structure.
- Are the dyestuffs original from the same sources used in the ancient techniques in the past?
- What are the lead times for producing a program with natural dyes?
- Does the increasing interest on natural dyes have any effect in the current fashion industry? Will the dyeing industry adapt itself and give importance to natural sources?
- To which extent does the demand for natural dyes mean an increase in the income of farmers in third world countries?
- Will this tactical plan strengthen Kuyichi’s brand awareness?
- Will this research be concluded with a systematic overview of activities and implementation plan?

Aim of graduation project:

The goal of this research is to prove, in terms of production, the feasibility for the successful introduction of garments with natural dyes in Kuyichi’s AW09 collection. Moreover, this research is part of a tactical plan that consists of launching a program with “green” t-shirts whose colours are 100% eco-friendly and are made out of sources traced back to ancient pre-Columbian textiles.
Chapter five
Desk Research
Desk research

The desk research started in February in Barcelona, Spain and continued in March in Haarlem, The Netherlands. This research phase was intended to gather information regarding previous studies such as multidisciplinary collaborations between Spanish associations aiming at analysing the dyes and dyeing systems used in historic fabrics from the Mediterranean area. The results obtained from these studies will be applied in order to search new sustainable industrial proposals.

At this stage in January 2008, I contacted the LEITAT Technological Center in Terrasa, Spain. Having talked to the specialists Meritxell de La Varga and Roshan Paul, helped me to understand the role of the associations involved in this investigation and the scope of this study. This way I learnt the new initiatives concerning sustainability for the professionals in the sector. This confirms that the industry is being altered in order to satisfy an increasing number of conscious consumers. What also impressed me is the social aim of merging the past with the present and the future, through tracing back the elements and the expertise used in the ancient art of making textiles, introduce them in nowadays industrial processes and present environmentally friendly proposals for the future.

After this meeting I prepared a plan of approach. This plan consisted in presenting a proposal to Kuyichi associating the studies performed in Spain with studies done about Pre-columbian textiles.

I approached this subject from three different points of view. First, a possible subject for my graduation thesis, second, a tactical plan and sustainable proposal for a fashion conscious company such as Kuyichi and third, consider historical facts concerning the study of ancient textiles in Peru and their applications in today’s industry.

The desk research phase continued in the Netherlands. At this time the research took place at Kuyichi’s headquarters in Haarlem. The first step within the company included internal research starting by an informal interview to the product manager. I collected sources of information regarding natural dyes. Except for some
swatches and a few samples of garment pigment dye with natural indigo, there were no previous studies done at the company concerning the sourcing of natural dyestuffs.

The subsequent activities were oriented to internet-based research and telephone contacts with dye-houses in Peru. The first contacts were possible thanks to Mr. Hugo Cardenas, the manager of Oro Blanco Sociedad Anonima (The cotton producer in Peru). This way I contacted three dye-houses: Ecotintes, Teñidos Naturales Inca S.A.C. and Tintoreria Internacional EIRL. These are the three dye-houses that perform the art of dyeing with natural dyestuffs in Lima.

The Suppliers

Following, a brief information about the three Dye Houses in Lima:

(a) Ecotintes

Ecotintes was founded to offer a natural dye alternative for cotton, wool, alpaca and other fibers, that guarantee a clean and sustainable product. It is friendly with the environment and free of dangerous chemical agents. Ecotintes resorted to traditional techniques, innovating technology and research to develop equipments and processes of minimum or null environmental impact.
(b) **Teñidos Naturales Inca S.A.C.**

Teñidos Naturales Inca is a company dedicated to manufacture organic cotton garments. Natural dyes and low-environmental-impact chemicals are used in the garment dyeing processes. This process combines contemporary methods with ancient Peruvian dyeing techniques.

Organisms that rule the industry accordingly certify all the materials used in their dyeing processes. Therefore Teñidos Naturales Inca’s garments are entirely ecological. Furthermore, their dyeing processes are soon to be certified by IMO (Institute for Market ecology)\(^5\) of Switzerland.

(c) **Tintoreria Internacional EIRL.**

This is a family-run dye-house that has inherited the dyeing technics of their ancestors in Apurimac, a province in the Andean region of Peru. They run the business in a still rudimentary way.

\(^5\) The Institute for Marketecology (IMO) offers certification according to GOTS standard with immediate effect. Recently IMO was significantly involved in developing the Global Organic Textile Standard (GOTS) and has been officially approved as the first certification body at all to offer certification according to this world-wide accepted standard for ecological textiles.
It was possible to manage the request of brochures and samples from the first two dye-houses, Ecotintes and Teñidos Naturales Inca. The first impression given by the dye-house Teñidos Naturales Inca was really positive. They provided us with a colour card, samples of dyed cotton and wool, list of prices, etc. With a couple of swatches we realized an experiment of colour fastness to light, having the first impression of the characteristic of a natural dye. The colour faded to a value of 3-4 using the grey scale with values ranging from 1 to 5.

The internet-based research was also intended to review historical information related to ancient textiles, documentations, museums, institutions, etc. These sources of knowledge would serve as background information for the project “dyes from yesterday, colours for tomorrow”.

**Dyes in pre-hispanic in the Andean**

The chromatic richness of Pre-Hispanic textiles demonstrates the ancient Peruvians’ knowledge of dyeing techniques in textile art. The early Pre-Inca cultures’ knowledge of complex textile manufacturing techniques and the wide range of colors of their cloths are admirable. Scientific research on this topic seeks to determine the chemical composition of the coloring agents used and to identify their origin.

In their colourful textiles, the ancient Peruvians reveal that they were adept at the processes of dyeing weaving and painting. They obtained dyes predominately from plant sources, as well as from some minerals and animals. These resources, together with the variety of naturally colored native cotton fiber and camelid wool that the ancient peruvians knew how to exploit, permitted them to obtain a wide range of colors. Peruvians cotton, a variety of Gossypium barbadense[^9], comes in different shades ranging from ivory to tan. The wool fiber used comes from South American camelids, a genus to which the Llama (Lama, glama),

[^9]: Pima cotton (Gossypium barbadense), also known as Extra Long Staple, South American, Creole, Sea Island cotton, Egyptian, Algodon pais, and West Indische katoen, is a species of cotton plant which is widely cultivated though it originated in Peru.
alpaca (Lama pacos), vicuña (Vicuña) and guanaco (Lama guanicoe) belong. Like cotton, the wool of these animals comes in several different shades.

The ancient Peruvians also knew how to use certain chemical substances, mordents and additives that influenced the resistance of the color during the dyeing process. Most dyes do not fix directly to the fiber and require these substances to do so. These chemical compounds which also affect the final color, include several types of aluminum salts, copper and iron, plant ashes, lime, tannin, urine and vinegar. Natural deposits of alum (Sulphate de aluminium and potassium) exist in the country, as do those of iron (iron sulphate) and of copper (copper sulfate). These minerals are known as soda, copperas and vitriol. Also black mud, with its high iron content was used in the sierra and rainforest as a mordant to darken colors.

Alkaline or acidic solutions help to fix the dyes that have a direct affinity with fibers and influence the final color of the dyes. Alkaline solutions tend to darken the color. These solutions can be obtained from plant ashes (lye) such as the pepper tree and seaweed. Acidic solution tends to brighten colors. Vinegar and other solution are obtained from different fruits (aceit acid) such as the pepper tree (Schimus molle) from which a brew is prepared that ferments into vinegar.[11]

Chapter six
Execution – Field Research
Execution – Field Research

The execution part of this investigation started with the Field Research of my project. This program took place in Lima. A one-month research trip was planned in order to arrange the development of t-shirt samples with natural dyes and to gather technical information regarding the use of natural dyestuffs in production.

The first persons approached for interviews were Mr Hugo Cardenas, The manager of Oro Blanco (the Cotton company in Lima). Mr. Cardenas provided me with information concerning the supply market of natural dyes in Lima and the companies performing this technics.

Mr. Cardenas also provided me with certain technical information and the ideas and possibilities for the production of tinctorial plants in Peru, specially the indigofera. It was quite inspiring to talk to him, because as a manager of a cotton production company, he knows a lot about the potential in the local textile market and the services. He also commented on the increasing interest of foreign companies in product developments with cotton, the famous Peruvian “white gold”.

Mr. Cardenas enlightened to me processes as the indigo dyeing process:

**Plants of the species (Indigo)**

Indigofera tinctoria (native to India and Asia) and Indigofera suffructiosa (native to South and Central America) are the best known. These indigo plants grow from 2 to 6 feet in height, have a single semi-woody stem, dark green oval leaves, and clusters of red flowers that look like butterflies and turn into peapods.

Indigo works by a chemical reaction called oxidation-reduction. Indigo does not dissolve in water. It must be reduced — i.e. the oxygen must be removed — in the presence of alkali by a reducing agent such as thiourea dioxide (thiox), sodium hydrosulfite, Zinc, or bacteria. Upon reduction, indigo becomes colorless and water-soluble. In this state, indigo has a high affinity for cellulosic fibers and enters the open spaces of the fiber. The dyed fibers are then exposed to air, which oxidizes the dye molecule back to its insoluble...
form. The insoluble dye particles are trapped inside the fiber, coloring them permanently blue. Unlike most dyes, indigo forms a mechanical, not chemical, bond.

**Technology**

Indigo is a vat dye, so named because the traditional processing of indigo included fermenting the leaves in a vat (vessel). The fermentation process reduces indican to its colorless, soluble form that fabric can absorb. To prevent premature oxidation, dyeing must take place in the absence of air. This fact dictates the technology of indigo dyeing. If one brushes the dye solution onto fabric, the brush might turn blue but not the fabric as the dye would become insoluble between the dye vat and the fabric. Traditional patterning of indigo-dyed fabrics usually depends on 1) fabric structure — mixing indigo yarns with other yarns, 2) physical resistance that prevent dye penetration, 3) chemical resistance that prevent dye oxidation, or 4) removal (discharge) of color after dyeing. A more recent option is the use of Inkodye, a soluble vat dye that has been preprocessed into the reduced form for direct application. \[^{[12]}\]

[^{[12]}]: http://www.hort.cornell.edu/plantsandtextiles/pdfs/indigo/introduction.pdf
**Tinctorial natural sources :** (Source: Teñidos Naturales Inca S.A.C.)

<table>
<thead>
<tr>
<th>Plant</th>
<th>Scientific name:</th>
<th>Common name:</th>
<th>Color obtained:</th>
<th>Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albahaca</td>
<td>Ocimum basilicum L.</td>
<td>Albahaca</td>
<td>green</td>
<td>coast and mountains up to 3000 m.s.n.m</td>
</tr>
<tr>
<td>Cochinilla</td>
<td>Dactylipus cocus</td>
<td>Cochinilla</td>
<td>Red, purple</td>
<td>Andean valleys</td>
</tr>
<tr>
<td>Lengua de vaca</td>
<td>Rubex obtusifolius</td>
<td>Lengua de vaca</td>
<td>brown</td>
<td>Andean valleys</td>
</tr>
<tr>
<td>Cantuta</td>
<td>Cantua buxifolia</td>
<td>Cantuta Jantu, Flor del Inca, Jinilo</td>
<td>yellow</td>
<td>coast and mountains up to 3000 m.s.n.m</td>
</tr>
<tr>
<td>Tara</td>
<td>Caesalpinia spinosa</td>
<td>Tara, acacia amarilla, dividi de los andes</td>
<td>grey</td>
<td>north of Peru</td>
</tr>
<tr>
<td>Indigo</td>
<td>Indigofera suffruticosa Mill</td>
<td>Añil, chacuapa maquin, llangua</td>
<td>blue</td>
<td>north of Peru</td>
</tr>
<tr>
<td>Chilca</td>
<td>Baccharis lanceolada</td>
<td>Chilca</td>
<td>Yellow, green</td>
<td>mountain and forests</td>
</tr>
<tr>
<td>Huito</td>
<td>Genipa americana</td>
<td>Huito, Huitol, Acuished ana</td>
<td>Light blue</td>
<td>mountain and forests</td>
</tr>
<tr>
<td>Eucalipto</td>
<td>Eucalyptus globules labill</td>
<td>eucalipto</td>
<td>Yellow, green</td>
<td>mountain and forests</td>
</tr>
</tbody>
</table>

*43*
Information gathering and sourcing

Kuyichi’s production broker in Peru, Iberoandina, and their representatives Milagro Paredes and Monica Foronda helped to set appointments and to outline their participation in the sourcing process of this project. Previous coordinations with Iberoandina helped to order a quantity of garments to be distributed among the dye houses for the first sample development. A factory tour was part of the first week. Visits to factories as Hitepima and Textiles La Victoria were scheduled in order to explain the purpose of my visit, inviting them to participate with ideas for the development of this research.

The sourcing program included meetings with dyers and visits to dye houses. The first dye house visited was Teñidos Naturales Inca S.A.C. Mr. Hernan Davila and Mr. Reynaldo Espejo provided us with information regarding the advances reached in the theme of natural dyes, the possibilities and limitations of the processes as well as information concerning the tinctorial sources. Information as colour fastness, laboratory tests and certifications were also provided. We were also given samples of natural dyes used in prints, which is something that other dye houses in this branch have not fully developed. Teñidos Naturales Inca S.A.C. is also the first dyeing company working with UV protectors to improve the colour fastness to light for vegetable and animal dyes. Their processes and production sources have been considered by IMO – The Institute of Marketecology in Switzerland, in order to guarantee their environmentally friendly performance.

Another acknowledged dye house in Lima is Ecotintes. A meeting was held with Ecotintes’ manager Mr. Ricardo Calmet and biologist Daniella Calmet. The dye house is a house-orchard located in the north of Lima. This dyeing-house is really a good option for handicrafts and goods produced in an artisanal way. They design, knit, weave and dye with fibres as cotton and wool. They seem to be good practitioners of the art. However their readiness to dye for industrial market I still limited.

The third dye-house visited was Tintoreria Internacional EIRL. Mr Florentino Guevara, wife and her daughters and a few workers are the human resource of this family-run company. They showed us how the dyeing processes occur. Colours are mixed and developments of samples take place in a small “laboratory”. The way of processing is rudimentary and it is deducted that therefore standards and homogeneity cannot be ensured.
The fourth dye-house we contacted was Dye and Finish S.A.C. Mr. Ricardo Tineo is a Textile Engineer and also the manager of this solely proprietorship. Samples with natural dyes for Hitepima’s client, Armani were developed in this dye house. Dye and Finish provided us with detailed technical information about natural dyes and work systems.

A limited quantity of garments was ordered at Iberoandina for the first samples development at Ecotintes and Teñidos Naturales Inca. However, it was possible to arrange an extra production of garments for Dye and Finish S.A.C.

The fabrics considered for the samples’ development included qualities such as: slub cotton (flamme,) single jersey in yarn counts like: 70/1, 50/1, 30/1 and 24/1 The intention was to test natural garment pigment dyes on different qualities to observe aspects as appearance and handfeel. Due to capacity and availability issues it was only possible to count on samples of single jersey in yarn counts such as: 50/1, 40/1, 30/1 and 24/1. Moreover, it was not possible to get all the samples from one specific batch. This caused that the garments sent to the dye houses showed irregularities and different appearances.

Dye and Finish was given an extra production of garments with some delay. This dye house was not considered in the initial program of activities. Consequently this dye-house did not manage to hand in the goods before the research period in Peru was finished. However they submitted the samples on the last week of May and they are now included in the research.

The colours’ and quality choice for the development of samples is resumed per supplier as follows:
During the development of the samples, I was given by one of the dye houses (Dye and Finish S.A.C.) a document that illustrates the technical characteristics, qualitative aspects and production-related information for the dyeing processes with natural dyestuffs. Here follows the translation of this document, originally in Spanish.

**Technical information**

**The dyeing process with vegetable dyes**

**Lab development:** The required colour is developed having as reference the colour on the fabric sent by the customer. It is strongly advised to develop the colour on the same fabric that will be used in production. The resultant colour is not identical to the sample sent by the customer. Natural dyes have different characteristics than synthetic dyes.
**Lab approval:** With the lab approval the dyer proceeds by dyeing a minimum mass quantity (1 kg. in garment dyeing) on the same material used in production. This will result in an approximation of the final quality on the garment with the Natural Dyeing and Finishing process. Commonly, what is sold is a minimum of 80% of the approved standard.

**Production:**

According to the following machines

1. **Samples:** Machine for maximum 1 kg of garments, regarding the type of article
2. **Production:** Machine for 15 – 20 kg, Machine of 40-50 kg. These are used according with the articles/materials worked out. The dye concentrations and their preparation in the colour formulations are referred to these weights, since these are important variables for controlling the dyeing bath. These colours are too sensitive to these variations.

Characteristic of process: It is an industrial process that optimizes the handcraft process of natural dyeing with natural dyes, improving the quality of them. This comprises:

**1. Process efficiency:** In a dyeing process the efficiency ranges from 80% to 95% with the continuous dyeing process. This depends a lot on the material to handle, colour, kind of process that has to be applied to obtain the colour and the machine where the processes are run. The most complicated are those that comprise the red colour, blue (indigo) and their combinations.

**2. Low reproducibility:** Every dyeing process is a new history, because the natural process depends basically on the dye extract and that in turn depends on several factors as the place of origin, harvest season, whether it is a flower / stalk or leaf that is used as a raw material to work out the extraction. Moreover, the low stability of the extract (can not be stored because the dye looses its strength) does not allow to reuse the same extract in a new process.
3. **Colours’ spectrum and intensity**: The entire colour’s spectrum can be obtained, except for black and the fluorescents / bright colours obtained with reactive dyes. With regards to the intensities, they range from light to medium-dark colours. Intense colours are not recommended because they require more concentrations of dyestuffs (therefore costs increase) and they present low colourfastness to wash and rubbing.

4. **Characteristics of colours**: Generally they have low brightness (when compared to reactive dyes), they have metamerism[^13^], some of them show dichroism[^14^] and they suffer a natural ageing process caused by light exposure, washing and rubbing. Its effect on the consumer has the “worn out” look of a denim garment.

5. **Articles to be worked out**: Basically the dyeing process is applied to garments and yarns (grey / bleached). It is also applicable to tubular pieces and knits (open fabrics), but for economical reasons it is not recommendable.

6. **Clean process**: It does not pollute the environment. Its effluents, the pH and temperature, the low quantity of solids, the high biodegradability of its components do not contribute to the pollution of the ECO system.

7. **Process cycle**: It is long because several factors must be taken into consideration: 1st) The cotton fibre 2nd) the dye extract, 3rd) The conditions of the plant to reproduce the right colour 4to) drying system, because they are sensitive to the thermal radiation, it is recommended a low drying temperature, making the cycle longer. For this reason, in production, the timing has to be considered and proper coordinations must be in place with the customer regarding delivery dates and prevention of quality problems in the

[^13^]: In colorimetry, metamerism is the matching of apparent color of objects with different spectral power distributions. Colors that match this way are called metamers.

[^14^]: Dichroism has two related but distinct meanings in optics. A dichroic material is either one which causes visible light to be split up into distinct beams of different wavelengths (colours) (not to be confused with dispersion), or one in which light rays having different polarizations are absorbed by different amounts.
development; for this reason the dyeing process considers that colour by colour must be worked out carefully to avoid any type of variation in the process.

**Fastness.**

All the natural dyeing sources have low to medium fastness in cotton and its blends. They are good or very good in protein fibres as (wool, camel hairs, angora and similars). The natural dyeing process has highly improved the classical fastness in cotton, besides allowing the colouring of the fibre itself. It can be summarized as follows:

**Light:** Vary according colors and intensity. The evaluation system considers the Gray Scales for color change, ranging from 1 to 5 being the minimum requirement 5. In the case of colors like: reds, blues, greens, and its blends, the result is the lowest fastness 2-3 / blues (indigo and its derivates): 2-3/ Yellows (New sources of colour): 3-4 / Greys and charcoal 3-4,4 / Pards and Browns: 3-4,4 / Beige and earthy: 3-4,4. In the case of intensity, the pastel colours and light s are those who have the lowest fastness 2-3.

**Washing:** The 40 °C tests is the only one that applies and all colours are between 3 and 4, except the reds and greens that are in 3.

**Rubbing:** Dry 3-4 and wet 2-3

**Transpiration:** Acid: 3, Alkalin: 2-3

**Frequent garment quality problems observed in production**

**Finishing:** the handfeel is soft, hydrophilic but not the synthetic handfeel of silicone. The colour fastness to wash and light may decrease. It is evaluated during development.

**Hue variations:** We determinate a work range of variations in the developments. When there are repositions or there is a reorder and there is a change of material, a new development is done on the new material.
The fabric’s batch weight has also to be considered, because the reproducibility is in function of this factor. Delivery times will have to be considered too, because above all, we first must standardize the extract before its application. If these conditions are not ensured, it could result in great variations in colours.

It is necessary to standardize the processing time with natural dyes, this will help to minimize colour variations.

**Exposure to thermal radiation:** This happens quite often in the printing process after natural dyeing and it is something typical of vegetable dyes. This pitfall can also occur during the drying process of the garments when drying temperatures are not properly controlled. It is highly recommended to inform the dyer on any subsequent process that the dyed garments go through. Natural dyeing can be done after printing, and a better effect comes out.

**Spots due to a great exposure to light:** Natural dyes, because of their particularities already explained, are affected when being firmly exposed to light. For this reason they must be kept away from a localized exposure to light. This can occur in any stage in production and in the stores when the garment is displayed in the windowshops. (think of the same considerations taken into account in a museum, light illuminates the surrounding area of the object/garment). Colour fastness of vegetable dyes has been improved with the introduction of a new yellow colour source (basic color in the colors trichotomy) achieving improvements in the fastness to light. However this control must be always considered.

**Garment Production Budget:** Under the process conditions (if the explained production stages are not monitored, the process becomes delicate and complicated), initially an additional of 20% (quantity of garments) of the requirement must be included in the budget. Obviously, this must be first evaluated and discussed between the internal (factory) and external customer (brand) since production costs will be affected and therefore the final costprice estimated for a ready garment will increase.

This can be discussed with the customer in order to manage this percentage in his sales budget. This situation must be improved with continuous work. The goal is to reduce this rate to 10%. It is worked on a long lasting
tendency, if there is a good positioning in the market, that way natural dyeing will be a better and workable option satisfying properly the needs of the market.

**The Supply Chain and Lead times**

The following diagram represents the production supply chain and the time-lines.

The supply chain considers the service of a local dyer. The total lead-time is 19 days.
Costs information

The next is a list of prices provided by two suppliers and as reference the price of reactive dyeing.

Prices per production volumes

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Ecotintes</th>
<th>Teñidos Naturales Inca</th>
<th>Reactive dyes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 120 kg.</td>
<td>12 USD</td>
<td>12 USD</td>
<td>8,00 USD</td>
</tr>
<tr>
<td>121 – 2,000 kg.</td>
<td>11,5 USD</td>
<td>11,45 USD</td>
<td></td>
</tr>
<tr>
<td>2,001 – 4,000 kg</td>
<td>11,00 USD</td>
<td>10,90 USD</td>
<td></td>
</tr>
<tr>
<td>4,001 – 6,000 kg</td>
<td>10,50 USD</td>
<td>10,36 USD</td>
<td></td>
</tr>
<tr>
<td>More than 6,000 kg</td>
<td>10,00 USD</td>
<td>9,82 USD</td>
<td></td>
</tr>
</tbody>
</table>

Prices per sample development (per colour)

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Ecotintes</th>
<th>Teñidos Naturales Inca</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 – 1,00 kg</td>
<td>20,00 USD</td>
<td>18,00 USD</td>
</tr>
<tr>
<td>1,00- 3,00 kg</td>
<td>16,00 USD</td>
<td>14,5 USD</td>
</tr>
<tr>
<td>More than 3,00 kg</td>
<td>12,00 USD</td>
<td>12,00 USD</td>
</tr>
</tbody>
</table>

Cost of dyeing service within garment cost structure (estimated)

<table>
<thead>
<tr>
<th>Selling Price garment (T-shirt)</th>
<th>Production Costs</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD 35,00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost Price USD 6,82</td>
<td>USD 0.61 Loan</td>
<td>9.00%</td>
</tr>
<tr>
<td></td>
<td>USD 3.80 Materials</td>
<td>56.00%</td>
</tr>
<tr>
<td></td>
<td>USD 0.02 Dyeing service</td>
<td>0.40%</td>
</tr>
<tr>
<td></td>
<td>USD 0.48 Contractor</td>
<td>7.00%</td>
</tr>
<tr>
<td></td>
<td>USD 1,91 Intermediary</td>
<td>28.00%</td>
</tr>
</tbody>
</table>
Chapter seven
Results and Evaluations


**Results and Evaluations**

The dyed garments were delivered except for the garment batch given to the supplier Dye and Finish.

The broker company in Lima and I checked the garments of both suppliers. Definitely Teñidos Naturales Inca S.A.C. delivered the best quality standard. Most of the garments showed good homogeneity and handfeel. The texture of the garment was soft. However some colours presented some spots and bleached parts. (Pictures)

In spite of that, Kuyichi’s opinion was positive. They observed the first results and expressed their desire to introduce the collection with natural dyes in AW2009. However, at the moment the only evaluation criteria is the garment appearance. The quality tests will definitely be an important reference to make further decisions regarding colour and garment quality choice. The colours and qualities selected for this collection must be defined by design and production.

As a matter of fact, the laboratory tests could not be developed in Lima. The main reason is the reduction of research costs. The option is to work out the laboratory tests at the Amsterdam Fashion Institute with the supervision of a teacher, the tests already started and the results will be shown at the final presentation.

Once the results are known, the supplier Tintes Naturales Inca will be contacted again. This exchange of information will help to define the quality desired by Kuyichi and will give feedback to the dyer for further improvements or advice.
Colour fastness tests results

The garments coloured with natural dyes were observed and tested in the Textile Laboratory of the Amsterdam Fashion Institute. The colourfastness was evaluated according to standard tests such as: fastness to light, fastness to rubbing and fastness to domestic and commercial laundry.

Colour fastness to light- ISO 105 B02

In the British Standard (BS) method the dyed cloth is exposed behind glass to daylight. The test specimens face south and are held at an angle to the horizontal equal to the latitude. The rate of fading of the specimen is assessed by comparison with the fading of a set of standard dyeings which are exposed at the same time. These are eight pieces of blue-dyed wool. They are numbered and the dyes have been chosen so that standard 1 fades about twice as fast as standard 2, which fades about twice as fast as standard 3 and so on. Dyes are classed with the number of the standard which fades at the same rate. The test of the International Standards organization is substantially the same as the BS test. The specimen was exposed to light for 72 hours.

Standard : 8 pieces of blue-dyed wool
<table>
<thead>
<tr>
<th>Supplier</th>
<th>Teñidos Naturales Inca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image1.jpg" alt="Image" /> <img src="image2.jpg" alt="Image" /> <img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Colour: Fading Value</td>
<td>Indigo: 5          Green: 1       Grey: 4      Brown: 3      Smoke: 3</td>
</tr>
<tr>
<td>Supplier</td>
<td>Ecotintes</td>
</tr>
<tr>
<td>Specimen</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image4.jpg" alt="Image" /> <img src="image5.jpg" alt="Image" /> <img src="image6.jpg" alt="Image" /> <img src="image7.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Supplier</td>
<td>Dye and Finish</td>
</tr>
<tr>
<td>Specimen</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image8.jpg" alt="Image" /> <img src="image9.jpg" alt="Image" /> <img src="image10.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Colour: Fading Value</td>
<td>Indian red: 1 Dark purple: 2 Medium brown: 1 Brown: 3 Green: 1</td>
</tr>
</tbody>
</table>
Colour fastness to domestic and commercial laundering - ISO 105 C06

This method is intended for determining the resistance of colour of textile to domestic laundering procedures. A specimen of textile in contact with specified adjacent fabric is laundered, rinsed and dried. The change in colour of the specimen and the staining of the adjacent fabric are assessed with both grey scales. The apparatus needed are: linitest, grey scales, 4 gr. ECE standard washpowder + 1 gr. perborate per liter, non-corrodible stainless steel balls and multifibre adjacent fabric containing a piece of WO, PC, PL, PA, CO and AC.

The procedure embodies stitching the specimen of multifibre fabric (10 x 4 cm) and the textile fabric (10 x 4 cm) together along one side with a white sewing thread. Then a liter of wash liquor has to be prepared. The linitest has to be put at the right temperature (40º Celsius). Additionally each container is filled with the right amount of wash liquid (150 mm) and the corresponding number of steel balls.

The containers are put in the linitest and then the machine must be run during 30 min. The results are assessed using the grey scales.
## Colour Fastness to domestic laundering- ISO 105 C06

<table>
<thead>
<tr>
<th>Col</th>
<th>Specimen (1)</th>
<th>S (4)</th>
<th>Multifibre adjacent specimen</th>
<th>Col</th>
<th>Specimen</th>
<th>S (4)</th>
<th>Multifibre adjacent specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supplier : Ecotintes</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Supplier : Dye and Finish</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navy Blue</td>
<td><img src="image1" alt="Image" /></td>
<td>3</td>
<td><img src="image2" alt="Image" /></td>
<td>Dark green</td>
<td><img src="image3" alt="Image" /></td>
<td>1</td>
<td><img src="image4" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2)</td>
<td></td>
<td><img src="image5" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td><img src="image6" alt="Image" /></td>
<td>2</td>
<td><img src="image7" alt="Image" /></td>
<td>medium brown</td>
<td><img src="image8" alt="Image" /></td>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(6)</td>
<td></td>
<td><img src="image9" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigo</td>
<td><img src="image10" alt="Image" /></td>
<td>4</td>
<td><img src="image11" alt="Image" /></td>
<td>indian red</td>
<td><img src="image12" alt="Image" /></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3)</td>
<td></td>
<td><img src="image13" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image14" alt="Image" /></td>
<td>2</td>
<td><img src="image15" alt="Image" /></td>
<td>mediu m brwn</td>
<td><img src="image16" alt="Image" /></td>
<td>1/2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(7)</td>
<td></td>
<td><img src="image17" alt="Image" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. On the left side the original colour, on the right side the specimen after laundering tests.
2. Wool, polyamide and diacetate changed the most in the multifibre adjacent fabric the value given was 4/5.
3. Multifibre adjacent fabric a the bottom shows the staining with value 4/5 for polyamide and wool
4. change in colour assessed with the grey scale
5. Wool, acrylic, polyester and polyamide have a value 4, cotton 3 and diacetate 4/5.
6. Diacetate has value 4/5 and bleached cotton 3/4
Colour fastness to rubbing- ISO 105 X12

This method is intended for determining the resistance of the colour of textiles of all kinds to rubbing off and staining other materials. Specimens of the textile are rubbed with dry rubbing cloth and wet rubbing cloth. The staining of the rubbing cloths is assessed with the grey scale. The apparatus used is a suitable testing device with a finger of 1.6 cm diameter. The Crockmeter Rubbing cotton cloth, bleached and cut into square 5cm x 5 cm. The gray scale is used for assessing staining (ISO 105-A03).

The Grey Scale for assessing change in colour.

The 5 steps scale consists of five pairs of non-glossy grey colour chips, which illustrate the perceived colour differences corresponding to fastness rating 5, 4, 3, 2 and 1. There is also a half-step fastness rating 4.5, 3.5, 2.5 and 1.5. Number 5 is excellent and number 1 is very bad. Artificial daylight must be used to assess the results (D65).
## Colour fastness to rubbing- ISO 105 X12

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Rubbing cotton cloth</th>
<th>Color: Staining value</th>
<th>Supplier</th>
<th>Rubbing cotton cloth</th>
<th>Color: Staining value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teñidos Naturales Inca S.A.C</td>
<td><img src="image1.png" alt="Image" /></td>
<td>Indigo: wet (3), dry (4)</td>
<td>Ecotintes</td>
<td><img src="image2.png" alt="Image" /></td>
<td>Indigo: wet (2), dry (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green: wet (3/4), dry (4)</td>
<td></td>
<td></td>
<td>Navy Blue: wet (1), dry (1/2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brown: wet (2/3), dry (4)</td>
<td></td>
<td></td>
<td>Grey: wet (1/2), dry (2/3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grey: wet (3), dry (4/5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dark Purple: dry (2/3), wet (1/2)</td>
<td></td>
<td></td>
<td>Middle Brown: dry (3), wet (1/2)</td>
</tr>
</tbody>
</table>

Dyes from yesterday, colors for tomorrow, by Arturo Rojas -IFM
Conclusions

Fastness to light
According to the minimum requirement of the ECLA (European Clothing Association) recommendation, the colour fastness to light should not be lower than 5 from a scale of 8 values.
Out of 5 colours dyed by TNI, the indigo colour passes the test. The green and brown colours fail. The garments were treated with an UV protector but this was applied to the garments in the last part of the dyeing process, being others the instructions The dyers received the UV material when the garments were in the last part of the process. The fastness to light does not meet the minimum requirements of ECLA norms, which is 5. Only the indigo colour meets this requirement. The supplier states that using the UV protector is something new for them. They applied this protection to the garments according to technical specifications of Quimica Suiza (a laboratory in Lima). However they did not make previous tests in order to see the effect of this new product on garment pigment dyed. The supplier states that this new product had negative effects in hues and also in intensities. Now it is shown that it also affected colour fastness.

The supplier Ecotintes delivered 9 different colours, from which the darkest were analysed. Colors like blue and light blue show a good fastness to light, grey and smoke tones have medium to poor fastness.

Samples of Dye and Finish were also evaluated, colors like red, purple and green again showed poor fastness by light exposure. These colors are definitively not recommendable at least further developments show the opposite.

Fastness to laundering
Again, according to the ECLA norm, the minimum requirement should be 4, regarding the gray scale that ranges from 1 to 5. The samples have undergone a washing temperature of 40 degrees.
Only the darkest colours were evaluated. The laundering tests suggest that most of the colours evaluated have low to medium fastness, being the best again the blue tones, value 5. The tobacco colour shows a regular fastness. Colours like green and red don’t pass the test. The dyes wash away.
**Fastness to rubbing**

The ECLA standard requires a minimum of color fastness to rubbing dry, value 4 and value 3-4 to rubbing wet. All the colours received from Teñidos Naturales Inca S.A.C. pass the rubbing dry and wettest. The rest of colours fail the test.
Chapter eight
Conclusions and recommendations
Conclusions and recommendations

- The laboratory tests carried out at the Amsterdam Fashion Institute under the norm of the European Clothing association, ECLA, indicate that the natural dyes used for this research do not comply with the minimum requirements of ECLA recommendations. These tests are valid for all kind of dyes because under regular circumstances like exposure to light, washing and rubbing, colours should have good fixative characteristics in our clothing. Natural dyes such as blue (in all colour shades), brown and grey show an acceptable fastness to all these tests.

- Natural dyes might not be competitive in a market conquered by synthetic dyes, in spite of this, natural dyes satisfy a niche in the market. This niche is willing to demand clothing with an emotional added value. This value satisfies a need that evokes: nostalgia, pureness, innocence and spiritual growth.

- Natural dyes are not always environmentally friendly. This statement is based on the usage of mordants in the process of natural dyeing. Mordants are harmful substances when they are abusively used. Mordants make possible that the dyeing substance penetrates the fibres of the substrate to be dyed. Since it is irresponsible to use much mordants for dyeing with natural colours, these tend to fade and experiment a natural ageing process.

- This research was conducted in Peru. The reason was tracing back the history of old Peruvian Textiles and the particular connection with the brand Kuyichi. However, other countries like India, Pakistan, Japan, Italy and England among others are good sources of natural dyeing and ancient dyeing techniques as well. The Netherlands counts on a high-quality dye source, *Rubia pigmentaria*, also known as *Madder Plant*. The root of this plant has been used since ancient times as a natural source for the red colour. It would be advisable to carry out further projects for introducing this pigment in fashion collections.

- A “tryout” with t-shirts dyed with natural sources would be a good tactical plan for Kuyichi. The concept of bringing back dyes from yesterday, found in ancient art (textile, tapestry, paintings and other objects) can generate the interest of the consumer and enhance brand awareness.

- The cost of natural dyes is essential information. The cost of dyeing with natural sources surpasses the garment pigment dye price with 50%. However, in a garment cost price structure the dyeing costs vary from 0.2 to 0.4% of the total costs.
• Since dyeing with natural sources is not a homogenized process, there is a risk to incur in reprocessing and ultimately to have non-reprocessable garments (waste). Therefore the production budgets must consider an extra amount (20%) of garments to be delivered in the dye house in order to prevent a shortage of clothing pieces after the dyeing service. The suppliers are working to diminish this high percentage.

• Kuyichi regularly places orders considering an extra production quantity of 5% calculated on basis of the 100% of the order. A 20% extra of garments is excessive. Eventually the percentage would be tolerated up to 10%.

• After the research conducted in Peru and having observed the first samples and executed the quality tests accordingly, the dye house that I would recommend for a trial with natural dyes is Teñidos Naturales Inca. Their performance was good and responsive compared to the other two dye houses observed. However, how sustainable they are in their way of proceeding is something that has not been studied yet. This dye house has approached the institute of Market Ecology of Switzerland, IMO. Teñidos Naturales Inca is pursuing an international certification.

• The shortest supply chain for using the service of natural dyes in Peruvian factories is achieved with the supplier Teñidos Naturales Inca S.A.C. Their dye house is located in Lima. Ecotintes and Dye and Finish S.A.C. dye houses are located a bit far from the city. Furthermore, all the raw materials, inclusive indigo, are sourced in the country. The lead-times for reproducing a colour from the colour card is 10 days. If a new development is requested the lead-times are longer (19 days).

• Environmentally friendly soap to wash eco-clothing would be also a good project to complement a program of t-shirts with natural dyes.

• Bright colours cannot be achieved with natural dyes. Natural dyes, like a plant, suffer an ageing process resembling a denim fabric. For some designers and brands, natural dyes are not an option. Natural dyes are not intended to replace the market of synthetic dyes but to offer an eco-friendly alternative to the consumer.
• An implementation plan is recommended considering the necessary developments before reaching the desired quality. This plan also will consider a time-line and cost information.

• The use of blue and grey colours might be considered because these show the best fastness to light. However it is again essential to inform the consumer that garment pigment dyed using natural dyes have different reactions to light than synthetic colours.

• Kuyichi wants to keep it simple regarding the colour choice. This means that Kuyichi will choose colours from the colour card of the dye house and not request a new colour development. The reason is that the colour card is already known and tested by the dyer.

• It has not been decided yet which kind of tops will be part of this program with natural dyes. It is estimated that 300 clothing pieces might be produced per colour and that the color range will consider 5 colours. The selling price will be the average of an organic cotton t-shirt. Approximately 30 euros.

• The red colour, produced with an animal dye source, the cochineal, has shown poor fastness to light, it would be advisable to use the Rubia pigment original from the Madder plant, which seems to offer a better colour fastness to light. However this plant does not grow in Peru.
References

[7] The term fashion in this case is used referring to other garments as t-shirts, sweaters, etc.
[9] The Institute for Marketecology (IMO) offers certification according to GOTS standard with immediate effect. Recently IMO was significantly involved in developing the Global Organic Textile Standard (GOTS) and has been officially approved as the first certification body at all to offer certification according to this world-wide accepted standard for ecological textiles.
[10] Pima cotton (Gossypium barbadense), also known as Extra Long Staple, South American, Creole, Sea Island cotton, Egyptian, Algodon pais, and West Indische katoen, is a species of cotton plant which is widely cultivated though it originated in Peru.
[13] In colorimetry, metamerism is the matching of apparent color of objects with different spectral power distributions. Colors that match this way are called metamers.

[14] Dichroism has two related but distinct meanings in optics. A dichroic material is either one which causes visible light to be split up into distinct beams of different wavelengths (colours) (not to be confused with dispersion), or one in which light rays having different polarizations are absorbed by different amounts.
Bibliography

Readers:
- Textiles Basicblock 2, International Fashion Management
  Lecturer: Ing. Jac. van Nes
  Amsterdam Fashion Institute AMFI

Books/Thesis:
- Tintes Naturales para lana de Oveja
  Por: Hugo Zumbühl
  Una edicion para la sierra central
  Impreso en el Peru
  Primera Edicion, diciembre 1979
- Clothing Technology...from fibre to fashion
  Third English Edition 2002

Magazines:
- Data textil,
  Edition Nr. 16:
  Published by Centre de Documentació I Museu Tèxtil de Terrasa – Spain
  England

Websites:
- www.ecotintes.com
- www.teñidosnaturalesinka.com.pe
- www.made-by.nl
- www.kuyichi.nl
- Colores perdurables, colores efímeros
  Los mordientes o fijadores en el proceso de teñido con tintes naturales Martha Cajias
  La Paz-Bolivia http://www.artesaniasdecolombia.com.co/documentos/documentos_pub/pcajias.htm
- Natural dyeing of textiles, Practical action, technology challenging poverty www.practicalaction.com
When natural is not the best choice; Editorial : More! News for the textile supply chain, www.dystar.com
Natural Dyes  By Gaurav Doshi http://EzineArticles.com/?expert=Gaurav_Doshi
Natural dyes: textile trends in Europe, Dr. Stefano Panconesi, PAI- Natural Color, 25-02-2005
Appendix

The name Kuyichi

Kuyichi Bv is a Dutch apparel company that sells trendy and sustainable fashion. Kuyichi designs, outsources and sells garments respecting working social conditions, environment and nature. Kuyichi produces fair trade and organic jeans & fashion, realised in a chain of global partners.

The name Kuyichi derives from the Peruvian god of the rainbow. According to the legend, the rainbow god of the Incas, indigenous of the ancient Peruvian civilization, became angry with the people and took all the colours away from life. After introducing and perfecting the art of weaving beautiful blankets, the Incas brought back the colours of the rainbow to the world. The brand Kuyichi has adopted this positivism from the Incas to challenge a new generation with pure and organic designs.

This legend, historical facts and today’s concern to preserve the environment, were the inspiration to start this research.
# Overview of activities – Peru, April 2008

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting with OB, Hugo Cardenas 447-1464 - 98858173</td>
<td>thu,10-04</td>
<td>Information gathering, concerning samples developed with natural dyes. Qualitative and quantitative info.</td>
</tr>
</tbody>
</table>
| Meeting with Gonzalo la Cruz (Solidaridad) Cel (+511) 9901 1901 | fri, 11-04 | • Gathering information on the market of natural and sustainable dyes in Lima.  
• Discuss the projects carried out by Oro Blanco and Solidaridad concerning natural dyes.  
• Define the person at Solidaridad who will follow the T&T training. |
| Meeting with Milagro Paredes and Monica Foronda IBEROANDINA. (Visit factories LA VICTORIA and HITEPIMA. Get explanation of processes.)Iberoandina Alberto del Campo # 468 Torre “B” Dpto. 704 San Isidro 264-3254 / 264-4949 Cel: 9814-6685 Nextel 814*6685 | mon, 14-04 | • Explanation of KUYICHI’s tactical plan  
• The role of IBEROANDINA  
• Inform time-table for T&T training by LV and HP, appointing the persons to be trained in both factories.  
• Tour through factory.  
• Map out processes.  
• Prepare agenda for visiting dyeing houses. |
| Meeting with Hernán Dávila and Reynaldo Espejo TEÑIDOS NATURALES INCA SAC. (Visit to factory with Milagro o Monica. Get explanation of processes). Telf. 481-6261 565-9030 Juan Salcedo 173, Urb. San Joaquin - Bellavista, Callao | tue, 15-04 | • Qualitative aspects of natural dyes  
  o Color fastness to (rubbing, washing, perspiration, light, ironing, etc)  
  o Are there different qualities among natural dyes?  
• What is the colors’ spectrum achievable? Is it also possible to get bright colors?  
• Are there any differences in prices by color?  
• Certification IMO – (Institute for Marketecology : Switzerland)  
• Lead-times  
• Dyes’ availability throughout the year  
• Production costs  
• Bottle necks, pitfalls |
<table>
<thead>
<tr>
<th>Date</th>
<th>Meeting with</th>
<th>Time</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>wed, 16-04</td>
<td><strong>Daniella Calmet</strong> and <strong>Ricardo Calmet</strong>&lt;br&gt;<strong>ECOTINTESTS.</strong>&lt;br&gt;<em>(Visit to factory with Milagro or Monica. Get explanation of processes).</em></td>
<td><strong>Gathering same information of TENIDOS NATURALES INCA SAC.</strong>&lt;br&gt;<em>(See above)</em>&lt;br&gt;Telf. 7845310 - 93383190</td>
<td>• New colors’ choice for garment dye (tests)</td>
</tr>
<tr>
<td>thu, 17-04</td>
<td><strong>José Tang</strong>&lt;br&gt;<strong>Textiles San Sebastián</strong>&lt;br&gt;<em>(9)94390824 - 4303000&lt;br&gt;Nextel: 8138669&lt;br&gt;<a href="mailto:Jose.tang@tssexport.com">Jose.tang@tssexport.com</a></em></td>
<td><strong>9:00 am</strong>&lt;br&gt;<strong>wed, 16-04</strong></td>
<td>• Organic Dyes (no natural dyes) but sustainable ones. Thorough dye processes. Recommended by Solidaridad. An alternative for quality and responsibility in dye processes.</td>
</tr>
</tbody>
</table>
| fri, 18-04 | **Florentino Guevara Blanco**<br>(Chemist and laboratorist) **TINTORERIA INTERNATIONAL EIRL.**<br>3710960 - 97429383 | **Information concerning old dyeing sources and technics and the use of mordants (fixatives) of low environmental impact. This chemist comes from a family of traditional dyers in Apurimac (Highland).** | • Technical information regarding ancient textiles, ancient dyes, mordants and dyeing techniques.  
• Cultures and periods in the Peruvian History to which they belong.  
• Make an inventory of dye sources used in the Pre Columbus Peruvian time (background information).  
• Make photography’s, gather material for using when communicating the value of ancient dyes to consumer. |
| sat, 19-04 | **Visit to Textiles del MNAAHP**<br>Museo Nacional de Arqueologia, Antropologia e Historia del Peru.  
Plaza Bolivar s/n Pueblo Libre  
T 4635070  
E-mail: mnaahp@inc.gob.pe  
Atención: martes a domingo de 9:30 a.m. - 5:00 p.m | **Information concerning old dyeing sources and technics and the use of mordants (fixatives) of low environmental impact. This chemist comes from a family of traditional dyers in Apurimac (Highland).** | • Technical information regarding ancient textiles, ancient dyes, mordants and dyeing techniques.  
• Cultures and periods in the Peruvian History to which they belong.  
• Make an inventory of dye sources used in the Pre Columbus Peruvian time (background information).  
• Make photography’s, gather material for using when communicating the value of ancient dyes to consumer. |
| mon, 21-04 | **Milagro Paredes** and **Monica Foronda**<br>**IBEROANDINA.**<br>*(Visit to factory LA VICTORIA and HITEPIMA explanation of processes)* | **Discuss impressions from both dyeing houses.**<br>**Review of tests. (feedback Kuyichi)**<br>**Compare suppliers qualitative wise.**<br>**Send samples to KUYICHI**<br>**Inventory of opinions IBEROANDINA**<br>**Make next appointment.** | • Discuss impressions from both dyeing houses.  
• Review of tests. (feedback Kuyichi)\(^1\). Compare suppliers qualitative wise.  
• Send samples to KUYICHI  
• Inventory of opinions IBEROANDINA  
• Make next appointment. |

\(^1\) Garment dyeing will occur in the week from April 7 and hopefully is done before the 16\(^{th}\) to discuss results with IBEROANDINA
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>exercises for T&amp;T training, taking into account processes in both factories.</td>
</tr>
<tr>
<td>Wed, 23-04</td>
<td>Training Track &amp; Trace – La Victoria</td>
</tr>
<tr>
<td>Thu, 24-04</td>
<td>Training Track &amp; Trace – Hitepima</td>
</tr>
<tr>
<td>Fri, 25-04</td>
<td>Review Track &amp; Trace – La Victoria</td>
</tr>
<tr>
<td>Fri, 25-04</td>
<td>Review Track &amp; Trace – Hitepma</td>
</tr>
<tr>
<td>Mon, 28-04</td>
<td>Review meeting with Milagro Paredes and Monica Foronda IBEROANDINA. Decision making meeting.</td>
</tr>
<tr>
<td>Tue, 29-04</td>
<td>Workshop “natural dyes from the amazon and the andes” Gladis Zevallos, Oscar Salomé MUSEO NACIONAL DE LA CULTURA</td>
</tr>
<tr>
<td>Wed, 30-04</td>
<td>Meeting with Margreet, Monica and Milagro to discuss conclusions</td>
</tr>
<tr>
<td>Thu, 01-05</td>
<td>Flying back Netherlands</td>
</tr>
</tbody>
</table>

- Training appointed person
- After care phase T&T (morning)
- After care phase T&T (afternoon)

- Discus the outcome’s qualitative and quantitative wise of both suppliers. (draw conclusions).
- Review KUYICHI’s feedback.
- Make supplier’s choice.
- Contact suppliers
- Make an inventory and documentation of fabricant’s requests for the application of natural dyes.
- Collect samples to bring to the Netherlands
- Discuss additional aspects concerning the application of natural dyes with design and production in Lima