

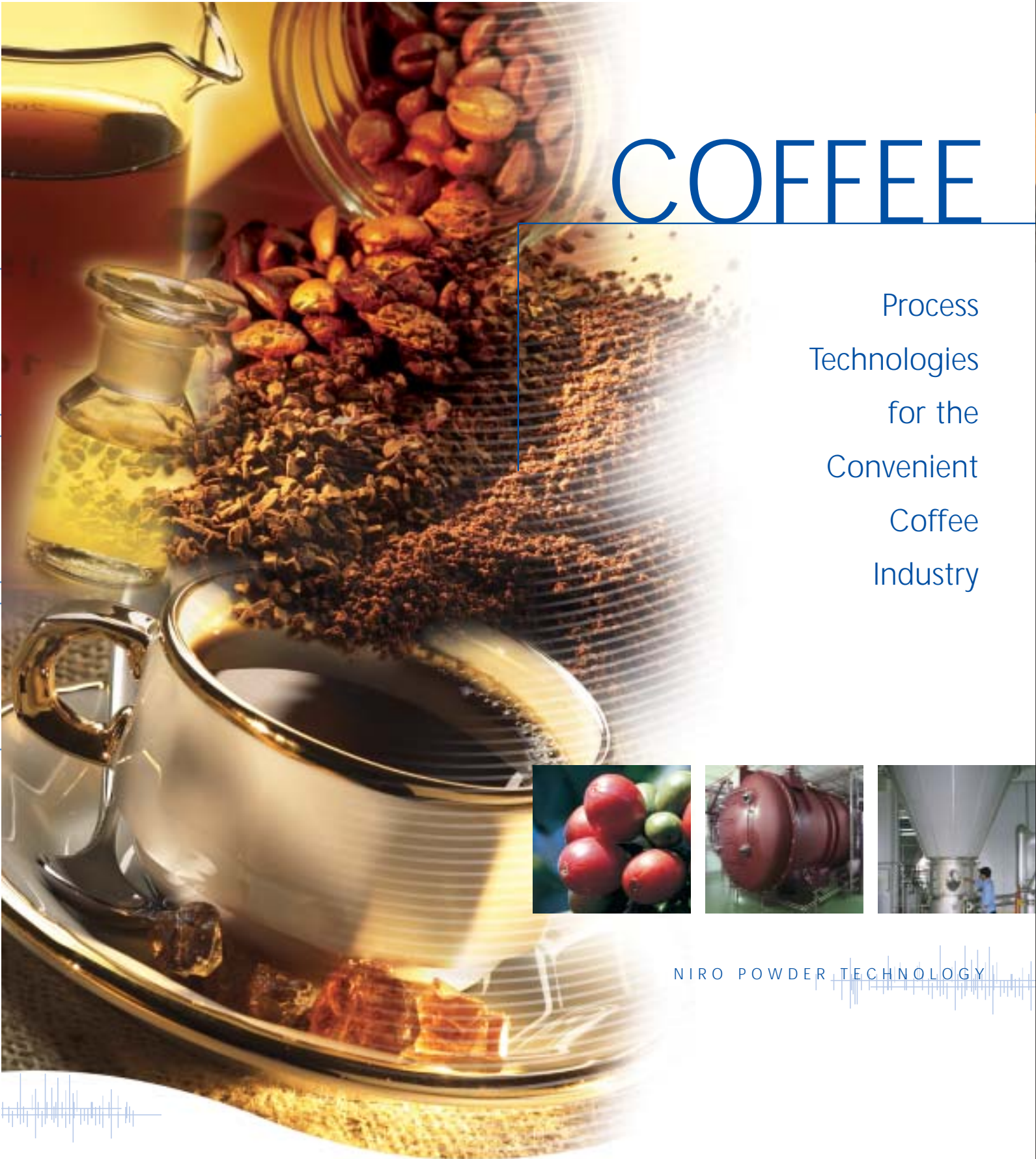


Process Engineering  
Division

Niro

# COFFEE

Process  
Technologies  
for the  
Convenient  
Coffee  
Industry



NIRO POWDER TECHNOLOGY



BLACK AS THE DEVIL,  
HOT AS HELL,  
PURE AS AN ANGEL,  
SWEET AS LOVE

*Arabic Proverb*

# Convenient Coffee Process Overview



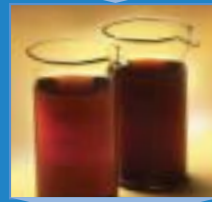
**Green Bean Treatment**  
*Solutions for cleaning, blending, and storage*



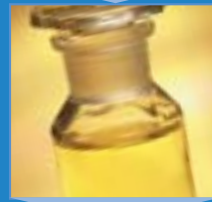
**Roasting**  
*Batch mode or continuous operation*



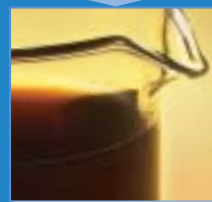
**Roast Bean Treatment**  
*Solutions for storage, grinding, and conditioning of the roasted product*



**Extraction**  
*Batch mode or continuous operation*



**Extract Treatment**  
*Clarification, storage and aroma recovery from the coffee extract*



**Concentration**  
*Freeze and thermal concentration, membrane filtration*

**CIP System**

*Fast and flexible  
Cleaning-In-Place features*

**Process Control**

*Plant supervision and monitoring, recipe control, and logging functionality*

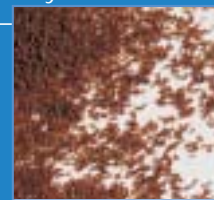
**Drying**

*The full range of solutions – only from Niro*

**NOZZLE TOWER™ -NT**



**Fluidized Spray Dryer -FSD™**



**FILTERMAT® Spray Dryer -FMD**



**Freeze Dryers**



**Agglomeration**

*For dustless powder and customized granules*



**RWA**



**Packing**

*Powder: Packed in bulk or retail quantities*

*Liquid: Supplied in cans or drums*





*Convenient*  
Perfection  
*for Every*  
Taste



Modern technology has made the full-bodied, aromatic, perfect cup of coffee convenient. And Niro makes it possible – every day, all over the world.

*Convenient Coffee Facts*

THERE ARE THREE MAIN SORTS OF COFFEE: ARABICA, ROBUSTA, AND LIBERICA. THE MOST POPULAR IS ARABICA, WHICH COMPRISES 75% OF THE GLOBAL COFFEE PRODUCTION.



## Setting the Standards

Coffee is pleasure. Its taste, flavour, aroma, and refreshing effect make it unique. It is also a product that attracts great attention in the food and beverage industry. And in the technology used to manufacture canned liquid coffee as well as regular and agglomerated instant coffee, Niro sets the standards for others to follow.

## Helping You to the Best Solution

A successful delivery is more than supplying the best plant available. Consumer requirements vary from market to market, and the coffee that commands a premium price in one market may fail completely in another. From a wide range of processing possibilities, we select the best plant type, layout, and operation to meet the customer's specifications of the desired product properties.

## The Proven Ability

We have maintained our leading position by repeatedly proving our ability to provide reliable and innovative technical solutions for the entire process from product testing to plant installation and after sales support.

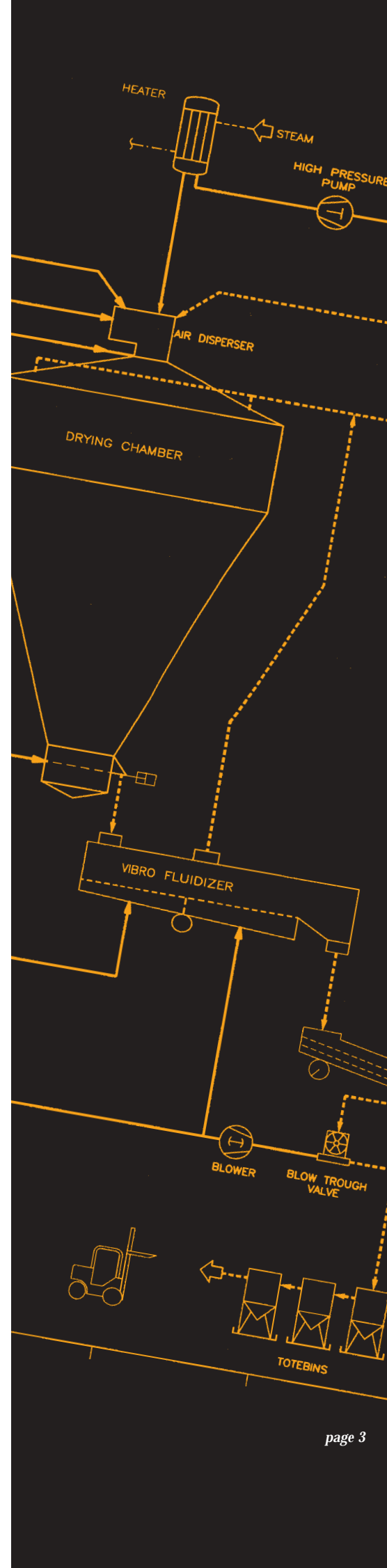
Our constant dedication to providing cutting-edge quality to our customers is the main reason why we have installed more than 180 plants for the coffee industry worldwide.

## A Complete Range

We supply solutions for all aspects of successful coffee production, making us the obvious supplier of individual plants as well as complete lines. Our solutions include our own unique technologies as well as equipment from trusted partners in coffee bean handling, roasting, and packing of the finished product.

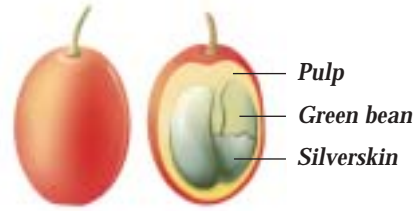
No matter the plant or process line, our customer will experience not only an increase in product quality, but also significant cost reductions due to efficient waste treatment and recycle systems.

Our commitment extends beyond the actual plants. A strong international network of companies gives our customers the comfort of local service combined with the quality that comes from global presence.





#### COFFEE FRUIT



# Quality Solutions

## *At a Glance*

### Great Coffee

#### Comes from Great Plants

Coffee beans are seeds from coffee fruits. After removal of the pulp, the green coffee beans are dried, cleaned and packed – typically in 60 kg bags – and stored until they can be roasted and, if required, decaffeinated.

Roasting is a delicate process, part art and part science, where the roast

master must decide exactly how long and hard the beans are to be roasted to get the desired result. It is during roasting that the beans acquire the flavour and colour of the finished coffee. The beans are now ready for sale to consumers.

Or they can be ground and processed into convenient coffee. And no matter the process, Niro knows how.

#### *Convenient Coffee Facts*

COFFEE BEANS ARE SEEDS FROM THE FRUIT OF THE COFFEE BUSH. WHEN ROASTED, THE BEANS LOSE 15-20% OF THEIR WEIGHT, BUT INCREASE UP TO 25% IN SIZE.





### Green Bean Treatment

- Cleaning
- Blending
- Storage

### Roasting

#### Roast Bean Treatment

- Storage
- Grinding
- Conditioning

### Extraction

- Fast instant coffee extractors (FIC™)
- Conventional batch percolators
- Continuous counter-current extractors (CONTEX™)

### Extract Treatment

- Aroma recovery
- Clarification

### Concentration

- Falling film and plate evaporators
- Freeze concentrators
- Membrane filtration systems

### Drying

- NOZZLE TOWER™ spray dryers (NT)
- Fluidized bed spray dryers (FSD™)
- FILTERMAT® spray dryers (FMD)
- Continuous freeze dryers (CONRAD™)
- Batch freeze dryers (RAY™)

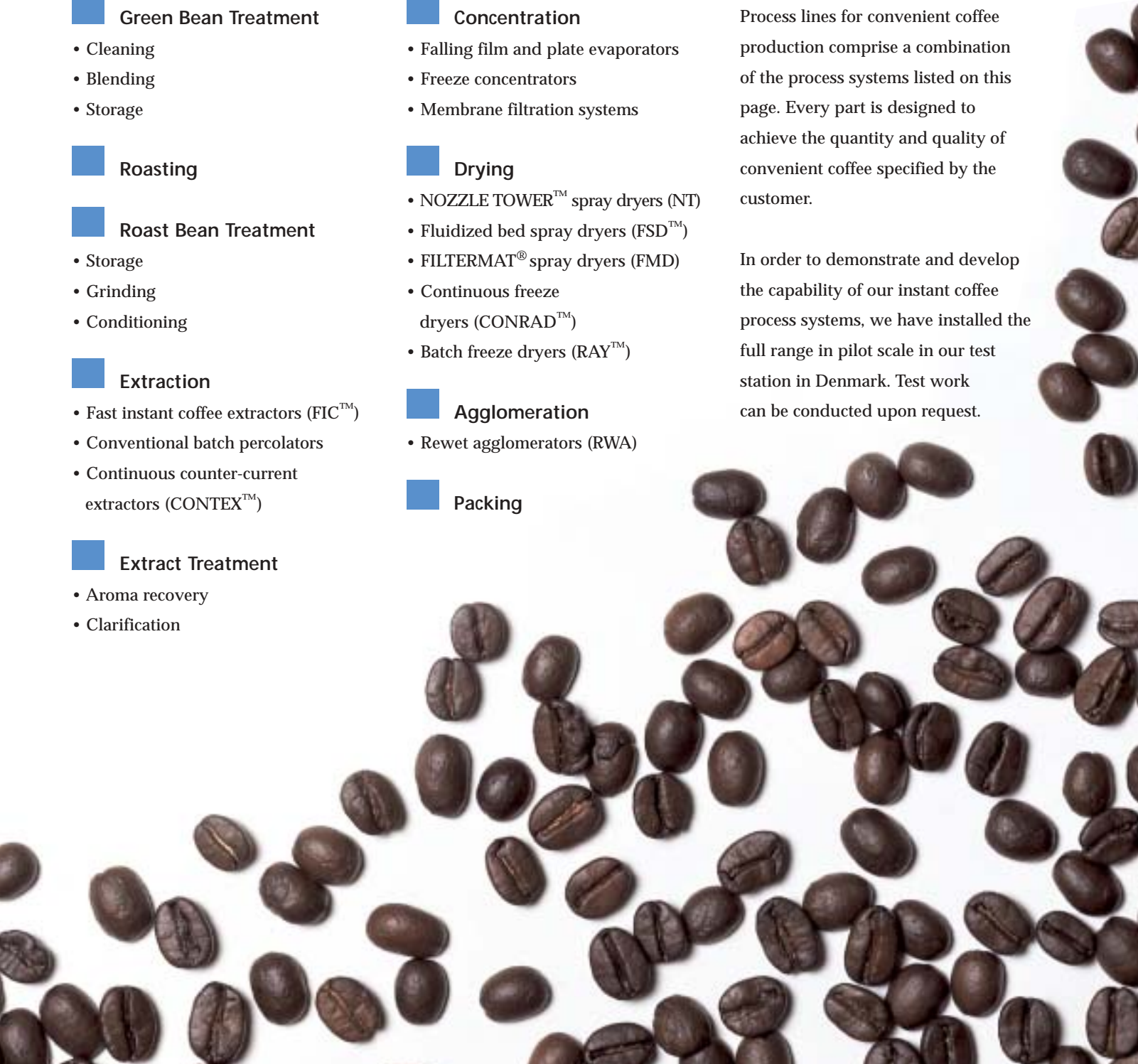
### Agglomeration

- Rewet agglomerators (RWA)

### Packing

Process lines for convenient coffee production comprise a combination of the process systems listed on this page. Every part is designed to achieve the quantity and quality of convenient coffee specified by the customer.

In order to demonstrate and develop the capability of our instant coffee process systems, we have installed the full range in pilot scale in our test station in Denmark. Test work can be conducted upon request.





# The Best Results

*Begin with the*

# Best Extracti

## *Convenient Coffee Facts*

A TYPICAL ARABICA COFFEE BUSH BEARS ABOUT 5 KG OF FRUIT PER YEAR. THIS CORRESPONDS TO ABOUT 300-400 GRAMS OF INSTANT COFFEE. FOR ROBUSTA BUSHES, THE YIELD IS SLIGHTLY HIGHER.

## **Extraction**

Niro's new and unique Fast Instant Coffee (FIC™) extractor is a continuous system that features automated multi-extraction percolators. Fully integrated with a PC/PLC (Programmable Logic Controller) system, the FIC™ yields a uniform extract quality.

## **Short Extraction Time**

### **– Superior Aroma Profile**

The FIC™ extractor reduces the extraction time by 50%. Water is directed through the ground coffee in two stages. The process results in two completely separate extract fractions, aroma and hydrolysis.

The FIC™ extractor gives a superior aroma profile, which is ideal for high quality convenient coffee production.

After the process is completed, the extract is filtered and centrifuged.

The layout of the percolator columns gives a compact design and reduces space requirements compared to standard battery extraction units.



*Conventional batch percolator – top view*



*Conventional batch percolator – bottom view*



on

The conventional batch extractor has a well-known design with the percolator columns in a straight line. With its proven efficiency, it is used in instant coffee plants around the world.

**High Yield**

Niro's extractors are designed to process a variety of coffee types as efficiently as possible. This gives the customer unparalleled flexibility and the highest obtainable yield.

*FIC™  
Extractor  
- top view*



*FIC™  
Extractor  
- bottom view*



# *Gentle Liquid Processing:* Extract Treat

*Freeze concentrator*



## **Aroma Recovery**

To prevent the desired, and volatile, aroma components in the extract from being lost during thermal concentration, the extract fractions are stripped of their volatiles in an aroma recovery unit. After being stripped from the concentrate in a flash evaporator, the aroma is recovered in a two-stage condenser system.

## **Clarification**

In order to achieve international standards for convenient coffee, clarification is an essential part of the process. A system consisting of filters and centrifuges is used to separate insoluble parts from the extract.

## **Concentration**

Concentration serves the dual purpose of increasing the solids content in the extract prior to freeze or spray drying, and making the process as economical as possible.

The aroma being quite volatile, lenient processing conditions throughout the

*Aroma recovery*

### *Convenient Coffee Facts*

IN 2001/02, THE  
GLOBAL COFFEE  
PRODUCTION TOTALLED  
OVER 6.6 MILLION  
TONS OF GREEN  
BEANS. THIS  
CORRESPONDS TO JUST  
UNDER 942 BILLION  
CUPS OF COFFEE.

# ment

concentration process are essential. Niro has developed a number of processes that maximize efficiency while being as lenient to the extract as possible.

#### **Thermal Concentration**

Our multistage non-recirculating evaporators operate under vacuum in a plug flow mode. They concentrate the coffee extract gently, quickly, and efficiently. In combination with the aroma recovery system, the evaporator preserves the aroma and taste components and produces an excellent concentrate for the production of convenient coffee.

#### **Membrane Filtration**

The aroma fraction of the extract can be pre-concentrated using reverse osmosis in a membrane filtration system. This slightly changes the taste profile, which is an advantage for some coffees and in some markets.

#### **Freeze Concentration**

With Niro's freeze concentration process, aroma loss due to thermal degradation is eliminated. By cooling the extract to subzero temperatures, excess water is removed as ice crystals. And this process requires no wastewater treatment, as the melted ice crystals are pure water.



**1. Evaporator  
- bottom view**

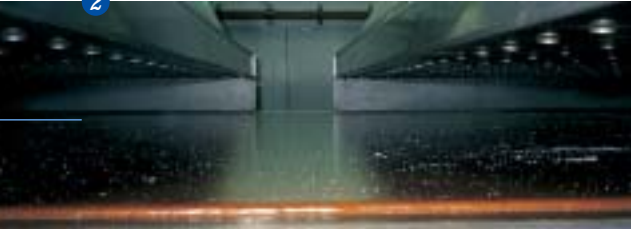
**2. Membrane  
filtration**





1 Foaming and prefreezing

2 CAB freezing



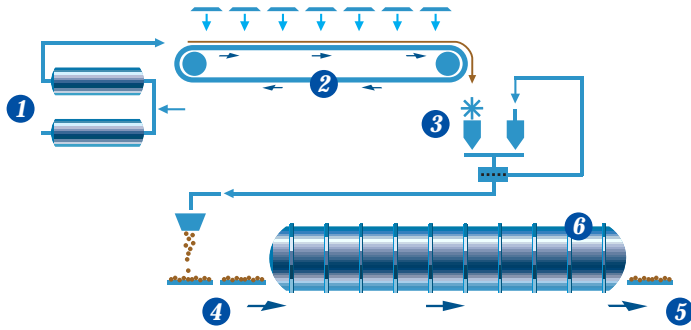
3 The frozen coffee is prebroken



4 Freeze drying: Tray going into the CONRAD™ freeze dryer



5 Freeze drying: Tray with the finished product



The Premium Product:

# Freeze Drying

Freeze drying preserves all the desirable aspects of the concentrated coffee extract. The finished product commands a premium price across the world by meeting market demands for quality parameters such as colour, density, and solubility.

The Atlas freeze drying process from Niro enables a unique degree of control over all of these crucial quality parameters.

RAY™ batch freeze dryer





**6**  
*CONRAD™ freeze dryer*

By using the proven Structure Control System (SCS), product colour and solubility as well as bulk density can be controlled during the pre-freezing process to meet any requirements.

Actual freezing can take place on a Continuous Air Blast (CAB) belt freezer or for smaller capacities on a Rota Drum freezer.

Granulation of the frozen coffee slabs in a carefully designed system ensures the right granule size and size distribution and completes the process prior to freeze drying.

The unique CONRAD™ freeze dryer protects all the qualities obtained in the concentrate during the full-automatic, continuous operation, and a first-class soluble coffee is produced thanks to the integrated control system for the entire process.

Our RAY™ batch freeze dryers are used for smaller capacity requirements or as add-on units to existing coffee processing plants.



*Freeze drying*

*Convenient Coffee Facts*

COFFEE IS GROWN IN A WIDE BELT AROUND THE EQUATOR. ROBUSTA COFFEE CAN GROW FROM SEA LEVEL TO 700 METRES ALTITUDE, WHEREAS ARABICA COFFEE MUST BE GROWN AT AN ALTITUDE BETWEEN 1,000 AND 2,000 METRES.



1  
Spray dryer  
- top view



2  
Spray dryer  
- side view

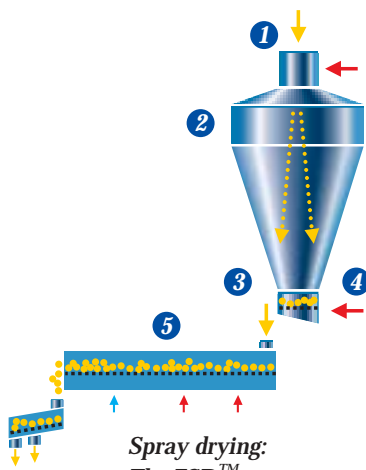


3  
Spray dryer  
- bottom view



4  
*Fluidized spray dryer (FSD™)  
with integrated fluid bed.*

## The Proven Quality: Spray Drying



*Spray drying:  
The FSD™ process*

### Spray Drying

The most economic method for producing soluble coffee is spray drying, which results in free-flowing and agglomerated/granulated powders. Thanks to an extremely high level of control, our customers can manufacture products meeting the demands of their individual markets.

The design of the spray dryer depends upon the specified powder properties, e.g. moisture content, particle size, and bulk density. Niro offers three designs for the manufacture of soluble coffee:



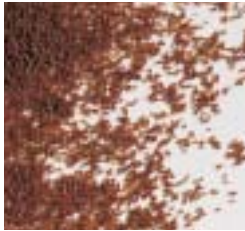
5  
**VIBRO-FLUIDIZER®**

*Convenient Coffee Facts*

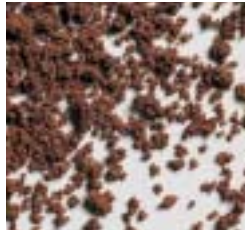
APPROX. 20% OF ALL PROCESSED COFFEE BEANS ARE USED FOR MAKING INSTANT COFFEE, A FIGURE THAT HAS BEEN STABLE FOR THE LAST DECADE.



**NOZZLE TOWER™  
-NT**



**Spray Dryer  
-FSD™**



**FILTERMAT®  
-FMD**

**NOZZLE TOWER™ (NT)** spray dryers are used for producing free-flowing powders comprising individual round, soluble beads with average particle sizes ranging from 100 to 250 microns. The tower-like chamber design results in a long residence time for the product to be dried.

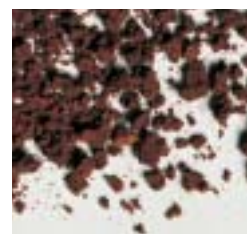
**Fluidized Spray Dryers (FSD™)**, equipped with an integrated fluid bed, are extremely compact. In order to achieve the required moisture

content and temperature of the instant coffee, post-drying and cooling are carried out in an external VIBRO-FLUIDIZER®. The FSD™s produce a free-flowing agglomerated/granulated coffee powder with average particle sizes between 100 and 300 microns. The lower temperatures during drying give improved aroma properties.

The **FILTERMAT® Spray Dryer (FMD)** with an integrated conveyor belt offers an even lower temperature

profile and longer drying times during the entire process. The result is a coarse, agglomerated/granular, free-flowing, and dustless powder with average particle sizes of 250 to 1000 microns with a greatly increased aroma retention.

With a proven ability of controlling powder properties to a unique degree, the operators of Niro spray dryers can adjust production to market trends and requirements.



**RWA**

**Rewet agglomerator**



**Agglomeration**

Different markets require different types of convenient soluble coffee. To meet the demand for granulated, dust-free products, the powder is processed in a Rewet Agglomerator (RWA). Material handling during the agglomeration process itself is specially controlled according to the desired properties of the end product. Average particle size is above 1000 microns.

*Meeting Every*  
**Requirement**  
*with the* **Best** *in CIP and Process Control*



#### Process Control

Controlling and monitoring a process line is of the essence for any operator. Niro's proven process control system meets all requirements for safety, flexibility, and ease of use.

Using standard hardware components, the process system enables you to:

- Supervise and monitor automatic plant start up, shut down, and cleaning procedures
- Work with several product recipes in one system
- Log every process activity for real-time and historical trending

Instrument and system specifications are selected in cooperation with our customer to ensure the best hardware service during the lifetime of the plant.

#### CIP System

Cleaning, while necessary, can be an expensive and time-consuming part of the process. Drawing on over 70 years of experience in working with sanitary processes, Niro has developed a series of Cleaning-In-Place (CIP) systems.

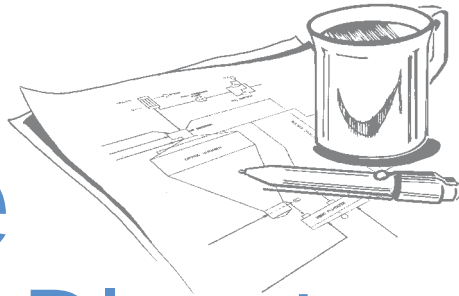
With features such as retractable nozzles in the main drying chamber as well as highly efficient process water recovery, the CIP system makes a significant contribution to the profitability of the entire process line.



**SANICIP™ bag filter - top view**

**Process control room**





# More than Just a Plant...

### Convenient Coffee Facts

CONSUMPTION VARIES: IN NORTH AMERICA, THE RATIO IS 4.4% INSTANT COFFEE TO 95.6% FRESH. IN EASTERN EUROPE, IT IS 65% INSTANT TO 35% FRESH, AND IN AUSTRALASIA, THE RATIO IS 78% TO 22%.

### A Partnership of Sharing

During engineering, commissioning/start-up and after-sales service we support our customers in their efforts to increase process profitability. A partnership, where both sides – Niro and the customer – learn about each other and share expertise and new experiences.

### A Partnership of Success

Niro is a resource in every stage of the project. We have the experience and know-how to ensure that all aspects are completed as smoothly as possible, including:

- Project financing
- Product testing at our test station in Denmark
- Process evaluation and optimisation
- Design and engineering
- Project management
- Plant delivery, installation and commissioning
- Training of plant operators
- Technical service and supply of spare parts

### Plant sizes

General operational data for Instant Coffee (IC) plants are given in the table. Available Sizes refer to the amount of kg that is produced each hour, i.e. an IC-250 plant will produce 250 kg of instant coffee each hour.

Available Sizes	IC-125	IC-250	IC-500
<i>Green coffee input (kg/h) 10% H<sub>2</sub>O</i>	275-375	550-750	1100-1500
<i>Roasted, ground coffee (hg/h) 6% H<sub>2</sub>O</i>	240-330	480-650	960-1300
<i>Yield %</i>	39-52	39-52	39-52
<i>Instant coffee (kg/h) 3% H<sub>2</sub>O</i>	125	250	500
<i>Annual production (t/year) Based on: 7,500 (h/year)</i>	940	1875	3750

A unique range of technologies and the service to match – these are the reasons why choosing Niro means entering a partnership of success.

# COFFEE

Process Technologies for  
the Convenient Coffee Industry

*Niro is a world leader in industrial  
drying, with spray drying, freeze  
drying, and fluid bed processing as  
core technologies. The Niro companies  
are part of the Process Engineering  
Division of the GEA Group.*



Process Engineering  
Division

A company of mg technologies group

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