

HEAT AND CONTROL

FRYER SYSTEM TECHNOLOGY





Heat and Control has been on a mission to modernize processing equipment since our founding in 1950. As process and product technologists, we are passionate about advancing food, pharmaceutical, and other industries with science and imagination.

We engineer, manufacture, and support modern industrial processing, coating, seasoning, conveying, weighing, packaging, inspection, and controls systems and equipment worldwide.

WHY DO WE FRY FOOD?



- Because it is an effective method of heat transfer
- To develop a desired appearance and/or texture
- To set the coating or the surface of a product

*...and because it makes
food taste good*



TYPICAL METHODS OF FRYING FOOD

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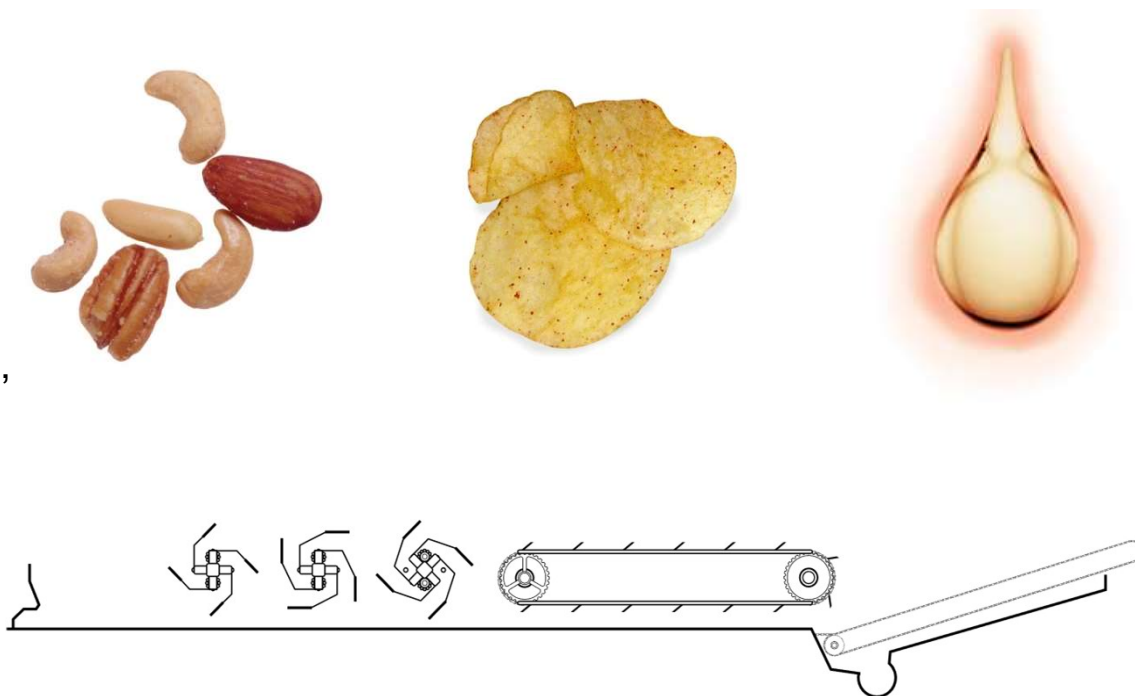
- Flash fry, oil blanch or par frying
 - The frying of product to prepare for downstream processing.
- Fully cook frying
 - The cooking of a finished product moisture content for shelf stability and proper product characteristics.



FRYER TECHNOLOGIES & CRITERIA FOR FRYER SELECTION

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- Frying Technologies
 - Vacuum fryers
 - Indirect/Externally heated fryers
 - Direct heated fryers
- Criteria for Fryer Selection
 - 1). Oil turnover rate / Oil pick-up: **Oil Management (OM)**
 - 2). Fines removal / Filtration (OM)
 - 3). Emissions
 - 4). System Heat Load & Heat Source (gas, steam, thermal fluid, etc.)
 - 5). Multi-Zone/Multi-Stage Frying
 - 6). Product characteristics and Production Needs



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VACUUM FRYING

Unitized Vacuum Fryer

VACUUM FRYING

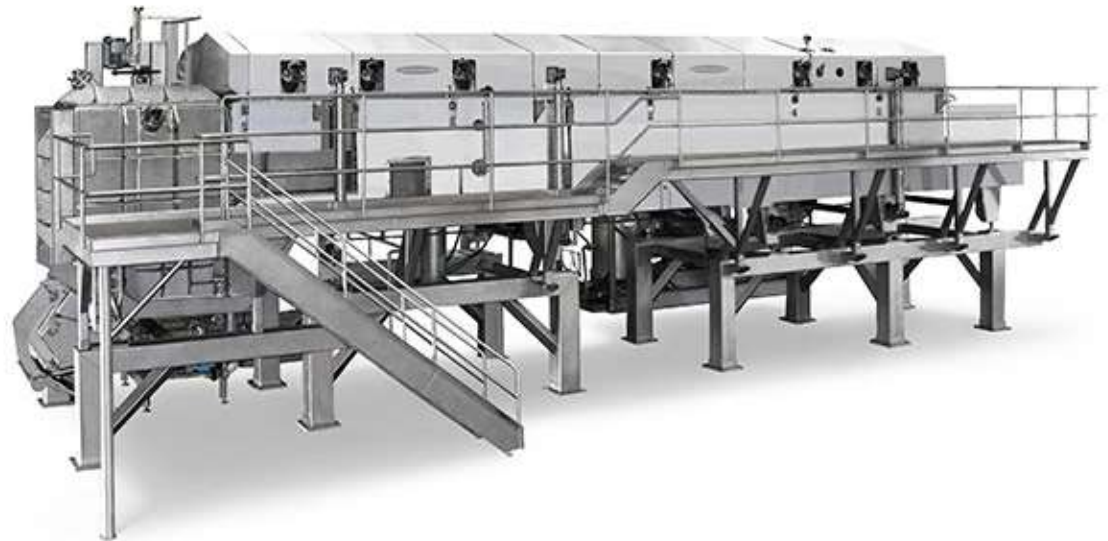
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Why fry in a vacuum?

- Cook high-sugar products, such as apples, carrots, sweet potatoes
- Produce lighter color in finished high-sugar products
- Reduce acrylamide

Characteristics of vacuum frying

- Operates at 5% to 10% of normal atmospheric pressure
- Water boils at a lower temperature
- Lighter color finished product
- Cooking can be done below the temperature at which acrylamides form



UNITIZED VACUUM FRYER

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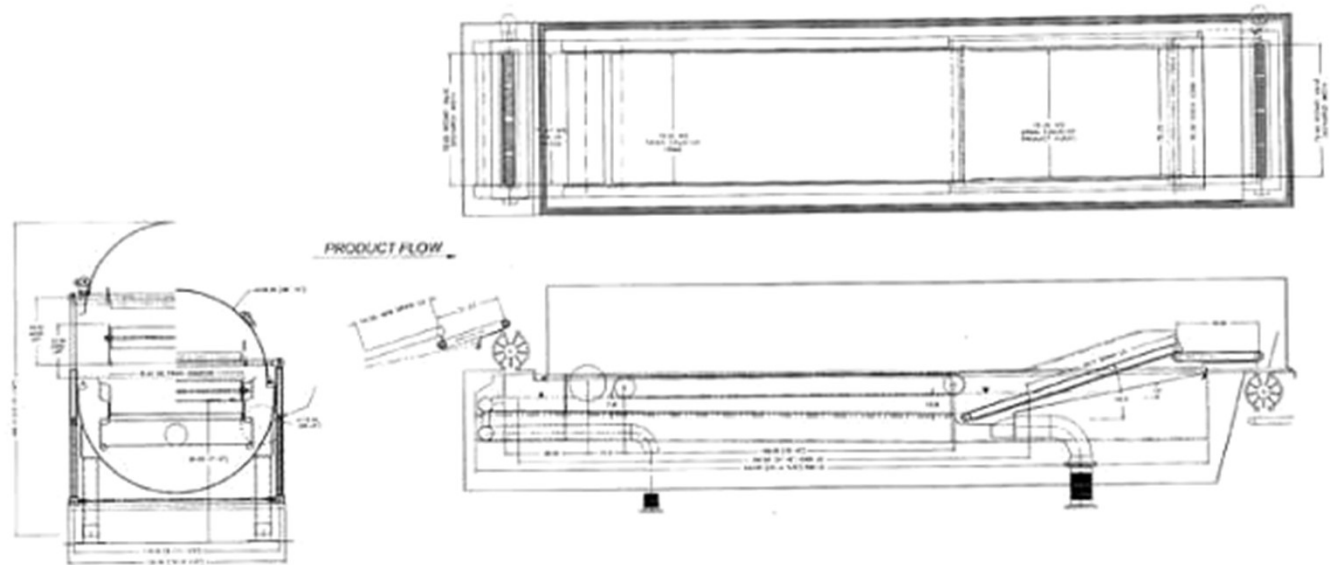


CONTINUOUS VACUUM FRYER WITH HEAT AND CONTROL UNITIZED TANK DESIGN

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Benefits Summary

- Lower price
- Greater capacity
- Reduced electrical energy consumption
- Less floor space required
- Easier to maintain



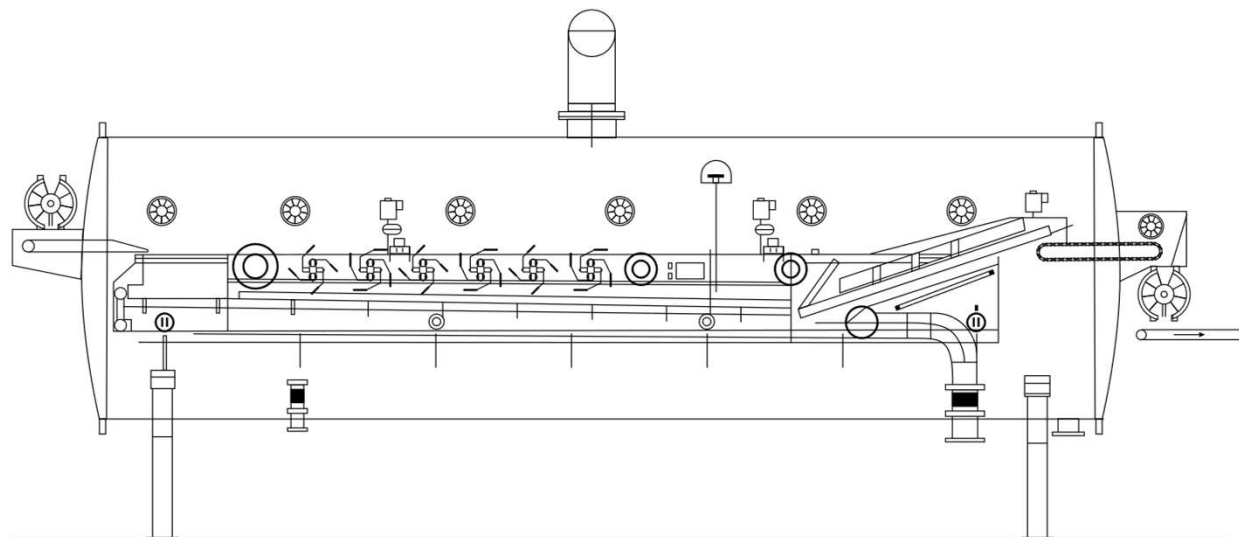
PROCESS ALTERNATIVES VACUUM FRYING

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Vacuum frying can be used as an alternative to conventional frying at atmospheric pressures.

Advantages include

- Water can be boiled off at temperatures below the acrylamide formation temperature
- Maintain better cooking oil quality due to near oxygen-free cooking environment
- Lower frying temperatures result in a lighter color finished chip
- Ability to cook products with a higher incoming sugar content, such as sweet potatoes
- Ability to use less stable (trans fat free) frying oils



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INDIRECT

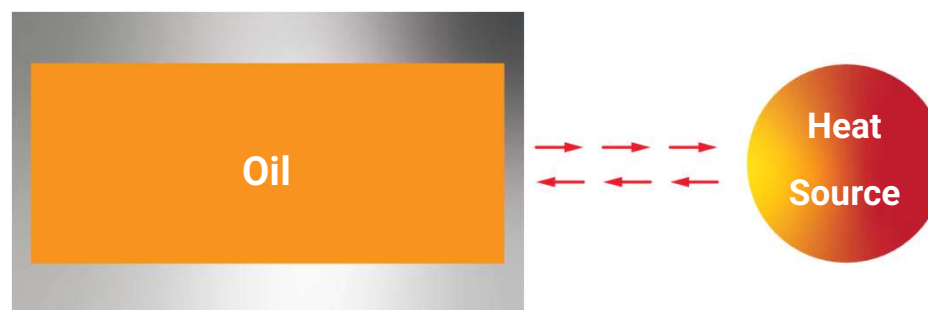
EXTERNALLY HEATED FRYERS

FRYER TECHNOLOGIES- Indirect Heated Fryers

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Indirect/Externally heated fryers

- A fryer system that circulates the cooking oil to and from an external heating source, such as:
 - Natural gas heat exchanger
 - Steam heat exchanger
 - Thermal fluid heat exchanger
- Potato chip, tortilla chip, pellet, nut fryers; co-products fryer; french fry fryer; Unitized Vacuum Fryer



Externally Heated Fryer



Indirect heated potato chip fryer

FRYING EQUIPMENT- Indirect Heated Fryers



Indirect/Externally heated fryers

- Fryer has "full flow" oil filtration and circulation
- Fryer sized for product requirements
- Heat exchanger heat load sized for moisture removal
- Extremely precise temperature control
- Lower system oil volumes with faster oil turn over rates
- Higher thermal efficiency
- Requires more floor space
- Higher initial investment



Potato Chip Fryer



Tortilla and Tostada Fryer



MasterTherm Fryer

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DIRECT

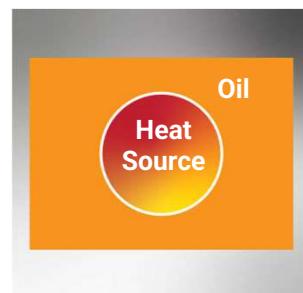
EXTERNALLY HEATED FRYERS

FRYER TECHNOLOGIES- Direct Heated Fryers

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Direct heated fryers

- Any fryer where oil heating is done inside the fryer
- Immersion tubes in the oil
- "Under pan" heating
- Fryer has little or no oil circulation
- Size of fryer governs heat input
- Larger system oil volume due to deep pan
- "Slip stream" oil filtration
- Longer oil turnover
- Requires overall less floor space
- Lower in initial investment



MasterMatic Fryer



MasterTherm Fryer

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Criteria For Fryer Selection

1). OIL TURNOVER RATE (Oil Pick-Up) ** OIL MANAGEMENT **



- Time required for product being cooked to absorb the total system oil volume
 - Expressed in terms of hours turnover
 - Calculation is done using the oil absorption into the finished product and the fryer system total oil volume
- Example
 - Total system oil volume: 800 pounds of oil
 - Oil absorbed into product: 100 pounds of oil per hour
 - Oil turnover rate: 8 hours
- Goal
 - Faster oil turnover is better
 - Oil turnover rates of over 8 hours are a "watch out"

1). OIL TURNOVER RATE (Oil Pick-Up) ** OIL MANAGEMENT **



- What Impacts Oil Turnover Rate:
 - Product
 - Coating Systems
 - Frying Temperatures
 - Product/Oil Flow Rates
 - Delta T
 - Drain Time
- And don't forget about the impacts of Air, Heat, Moisture, etc. They are not always your friends!

2). FINES REMOVAL & FILTRATION (TWO METHODS ARE AVAILABLE)



Active

- Active filtration is where the negative components of oil created by the frying process are chemically removed or altered by chemical addition of additives, such as an *adsorbent*.
- And *adsorbent* creates a reaction where molecules created by the break in the polymer (oil) chain adheres to the outer surface of the treatment processing aid. It becomes chemically bound to the that aid and is removed through high efficiency filtration.

Passive

- Passive filtration is where fines and particles are physically removed through mechanical action, such as screening or centrifugal action.

*Filtration is the critical step
in any frying process*

2). FINES REMOVAL AND OIL FILTRATION EQUIPMENT



The type of filtration used will depend upon:

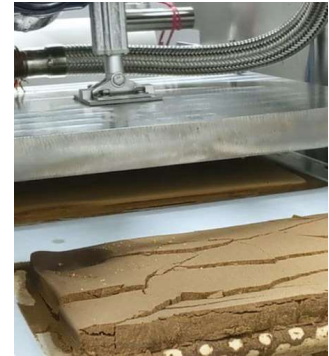
- Particle size
- Volume of particles
- Sinking or floating characteristics of particles
- System oil volume/flow rate
- Filtration system cycle rate
- Type of fryer selected



Continuous
Paper Filter



Motorized
Catch Box



Pressurized or
Suction Filters

2). FINES REMOVAL AND OIL FILTRATION EQUIPMENT



Full flow filtration systems

- Typically filters the entire system volume every minute or faster
- Drum Pre-Filter
- Motorized Catch Box
- KleenSweep centrifugal filter



Drum Pre-Filter



KleenSweep



Motorized Catch Box
on Fryer Support
Module

2). FINES REMOVAL AND OIL FILTRATION EQUIPMENT

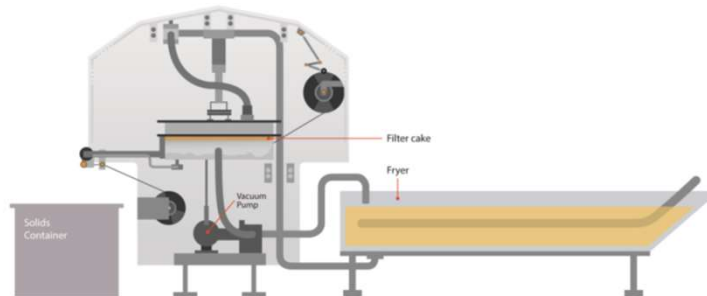
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"Slip-stream" filtration systems

- Typically filters total system oil volume 4 -10 times per hour
- Suction Filters
- Continuous Belt Filters
- Canister Filters



Continuous Belt Filter



Suction and/or Pressure Filter



Canister Filter

3). EMISSIONS AND POLLUTION CONTROL



Environmental concerns are on the rise and need to be considered when selecting a frying system.

- Effluent is created by frying - primarily oil and steam particles
 - Oil Mist Eliminator
 - Scrubbers
 - Incinerating Systems
- Byproducts of Combustion – CO, CO₂, NO_x
 - Best Available Components
 - Burner Equipment Maintained Properly



KleenHeat®
pollution control
heat exchanger



3). EMISSIONS & POLLUTION CONTROL- Heat Exchangers Alternatives



Model CTHX

Coil-Type Heat Exchanger



Model HX

Horizontal Heat Exchanger



Model KHX

Pollution (Emission) Control Heat Exchanger



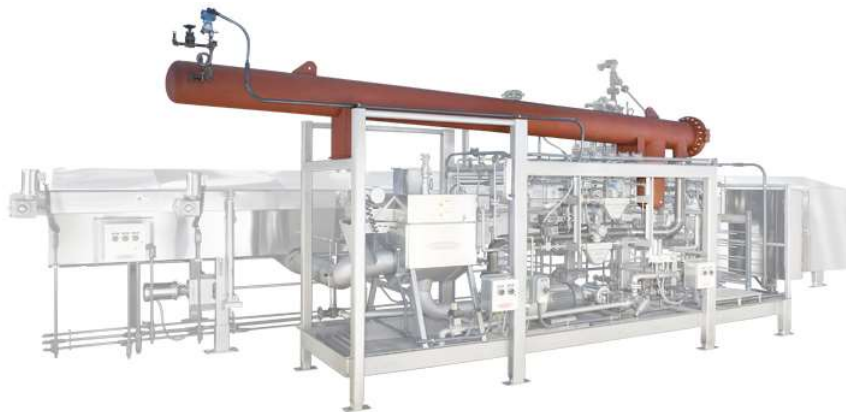
3). EMISSIONS & POLLUTION CONTROL- Heat Exchangers

Alternatives: Steam, Thermal Fluid, etc.

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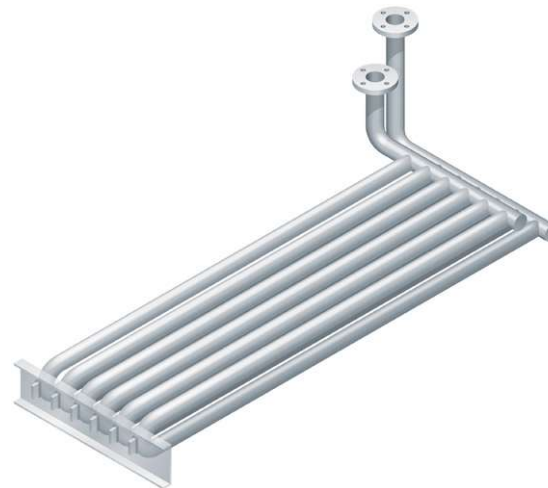
Shell & Tube

Steam or thermal fluid
heat exchanger



Fluid Serpentine

Steam or thermal transfer
heat exchanger



4). SYSTEM HEAT LOAD AND HEAT SOURCE



Heat load

- Heat required to
 - Evaporate the moisture (H₂O) in the product
 - Heat the solids in the product
 - Heat make-up cooking oil
 - Compensate for radiant losses off the fryer
 - Rate of heat recovery

Heat source

- Natural gas
- Propane / butane / methane
- Fuel oil (#2, kerosene, heavy oil)
- Steam
- Thermal fluid
- Electricity



5). FRYING EQUIPMENT: Multi-Zone/ Multi-Stage Frying



- Zones or Stages are used to develop/control heating curves and the process
- Multi Zone fryers use multiple inlets and outlets controlling oil flow rates and delta T's
- Multi-Stage frying systems use multiple fryers in series
- Product characteristics can be varied utilizing these type of fryer configurations

6). PRODUCT CHARACTERISTICS AND PRODUCTION NEEDS

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Coated

- Tempura Batter
- Seasoned Flour
- Bread Crumb



Non-Coated

- Meatballs
- Turkey Breasts
- Turnovers/Fried Pies
- Eggrolls



Shaped

- Taco Shells
- Tostadas, etc.



6). PRODUCT CHARACTERISTICS AND PRODUCTION NEEDS

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Fryer Area

- Physical area of fryer required to accommodate the desired output capacity
- Area required to prevent product defects



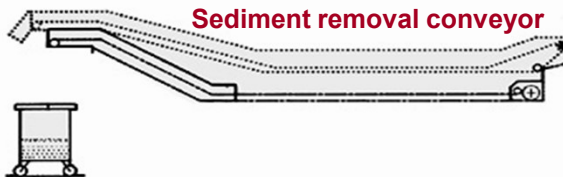
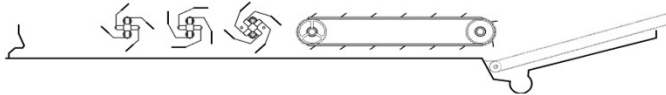
Dynamic Action Fryer

6). PRODUCT CHARACTERISTICS AND PRODUCTION NEEDS

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Fryer Area & Product Conveyors

- Product buoyancy (sink or float)
 - Fryer loading (lbs/hour/sq ft)
 - Free-fry requirements
 - Incoming product orientation
 - Coating on product
 - Fines removal



SUMMARY



- Frying of foods will always exist as a viable process regardless of the complexities involved in the mechanism of heat transfer through the use of an elevated temperature cooking oil. This process can be monitored and controlled if the basic principles of frying and oil management are understood.
- The selection of the correct equipment for the application, along with defined operations and the proper maintenance, will result in a high-quality fried food product that will satisfy the ever-changing requirements and dynamic eating habits of today's global consumer- and... **Higher Profits!!**

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QUESTIONS?



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The logo consists of a red oval with the text "HEAT AND CONTROL" in white, bold, sans-serif capital letters. A small registered trademark symbol (®) is located at the bottom right of the oval.

HEAT AND CONTROL®

**LOOKING BACK.
PRESSING FORWARD.
ALWAYS INNOVATING.
SINCE 1950**