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# Computer Programs

- LSLoad
- WinFreeze
- Thermophysical Properties Calculator
- HydroCool

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## LSLoad

- Determine Sensible and Latent Heat Loads in Bulk Storage of Fruits and Vegetables
- Determine Moisture Loss
- Determine Commodity and Air Temperature Profiles

# LSLoad: Data Input

- Commodity Type
- Initial Commodity Temperature
- Dimensions of Bulk Load
- Air Temperatures
- Air Flow Rate

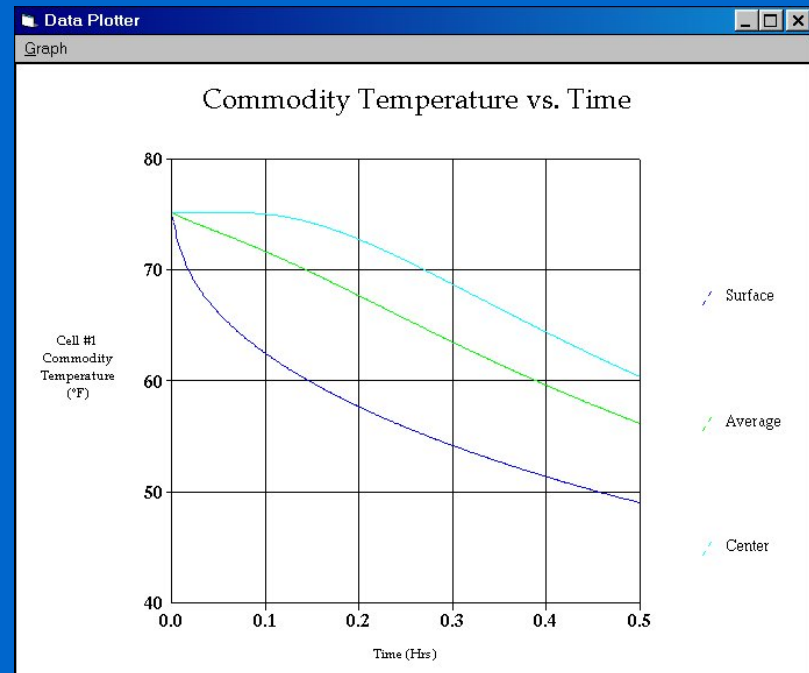
The screenshot displays the 'LSLOAD for Windows 1.0' application window. The title bar includes standard Windows window controls. The menu bar contains 'File', 'Advanced', and 'Graphs'. The main window is titled 'LSLOAD Data Input Sheet' and contains the following fields:

|                                       |          |          |
|---------------------------------------|----------|----------|
| Case Title:                           |          |          |
| Bulk Load of Apples                   |          |          |
| Commodity Type                        | Apples   |          |
| Initial Temperature                   | 75.2 F   |          |
| Bulk Load Weight                      | 1764 Lbs |          |
| Bulk Load Dimensions                  | Height   | 3.238 ft |
|                                       | Width    | 3.238 ft |
|                                       | Depth    | 6.463 ft |
| Refrigerated Dry Bulb Temperature     | 35 F     |          |
| Refrigerated Air Wet Bulb Temperature | 33.8 F   |          |
| Refrigerated Air Flow Rate            | 1032 CFM |          |
| Storage Time                          | 0.5 Hrs  |          |

At the bottom of the form, there is a 'Calculate' button and a 'QuickUnits' section with radio buttons for 'English' (selected) and 'Metric'.

# LSLoad: Data Output

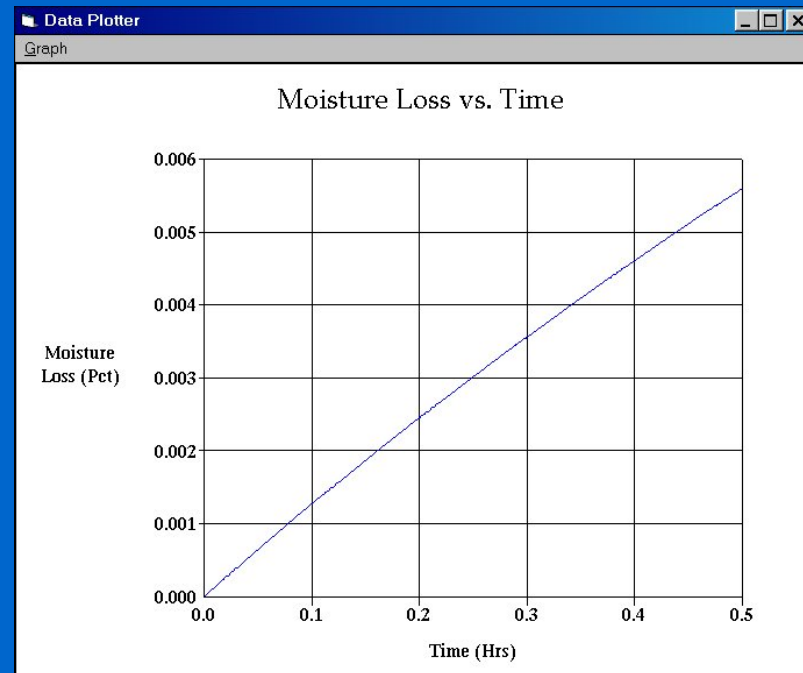
- Plot Commodity Temperature vs. Time
- Center, Average and Surface Temperature



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# LSLoad: Data Output

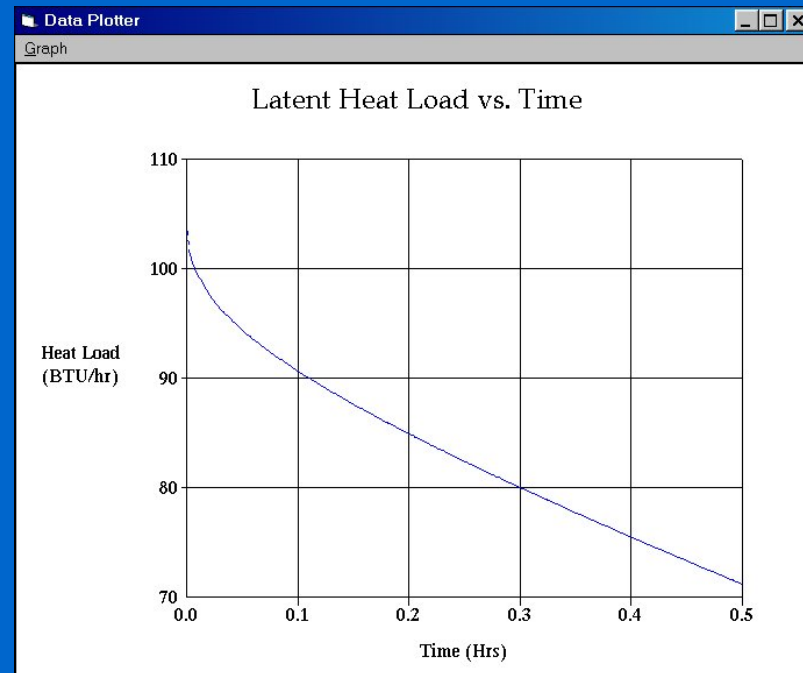
- Plot Moisture Loss vs. Time



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# LSLoad: Data Output

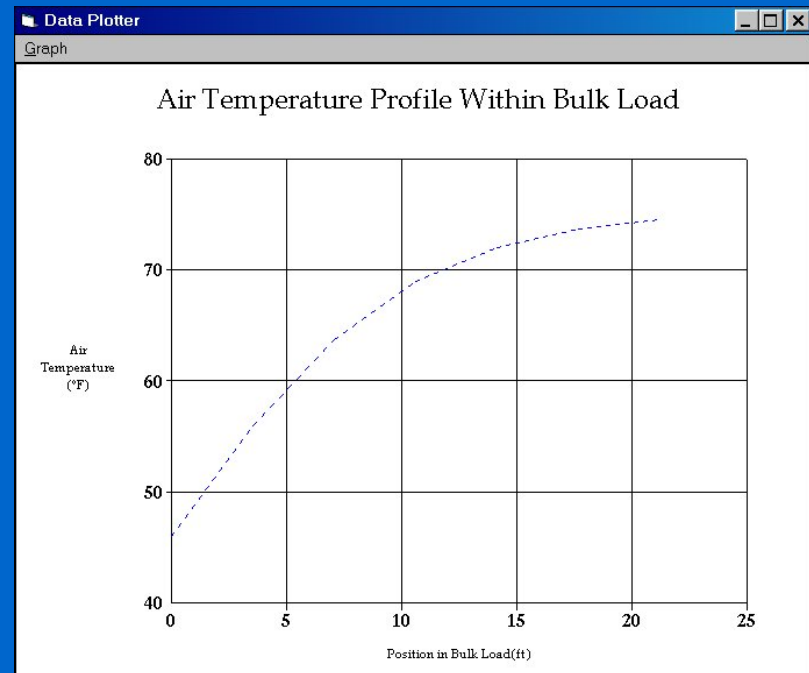
- Plot Latent or Sensible Heat Load vs. Time



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# LSLoad: Data Output

- Plot the Air Temperature Profile within the Bulk Load





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# WinFreeze

- Calculate Cooling or Freezing Times of Foods
- Calculate Refrigeration Loads

# WinFreeze: Data Input

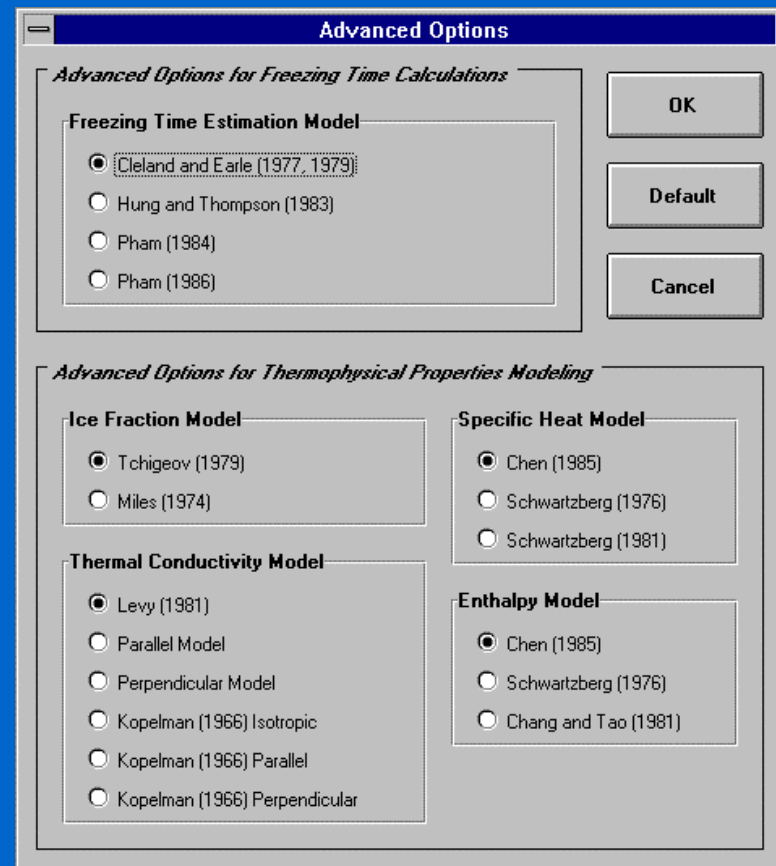
- Initial and Final Food Temperature
- Food Shape and Dimensions
- Cooling/Freezing Medium Temperature
- Surface Heat Transfer Coefficient

The screenshot shows the WinFreeze software interface with the following sections and controls:

- Process Name:** A text input field for the process name.
- Process Parameters:** Four input fields for:
  - Initial Food Temperature (°C)
  - Final Food Temperature (°C)
  - Cooling/Freezing Medium Temperature (°C)
  - Surface Heat Transfer Coefficient [W/(m<sup>2</sup>·°C)]
- Food Geometry:** A dropdown menu for Geometry Selection (currently set to "Infinite Slab"), and three input fields for Slab Thickness (m), Dimension #2, Not Required, and Dimension #3, Not Required.
- Thermophysical Properties of the Food:** Two radio buttons: "Direct Input of Properties" (selected) and "Computer Generated Values of Properties".
- Buttons:** "Enter Data", "Advanced . . .", "Calculate", "View Results", and "Exit".

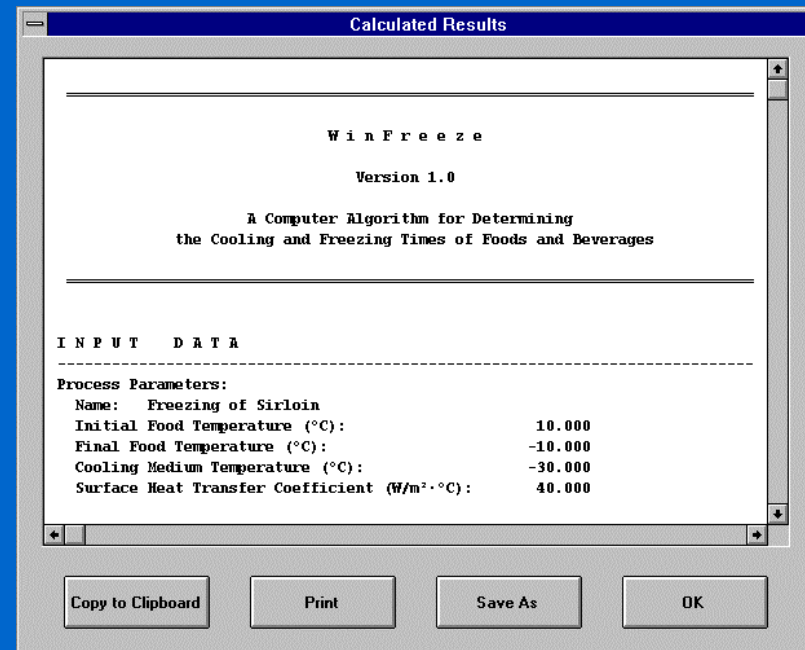
# WinFreeze: Advanced Options

- Select a Freezing Time Model
- Select Thermophysical Property Models



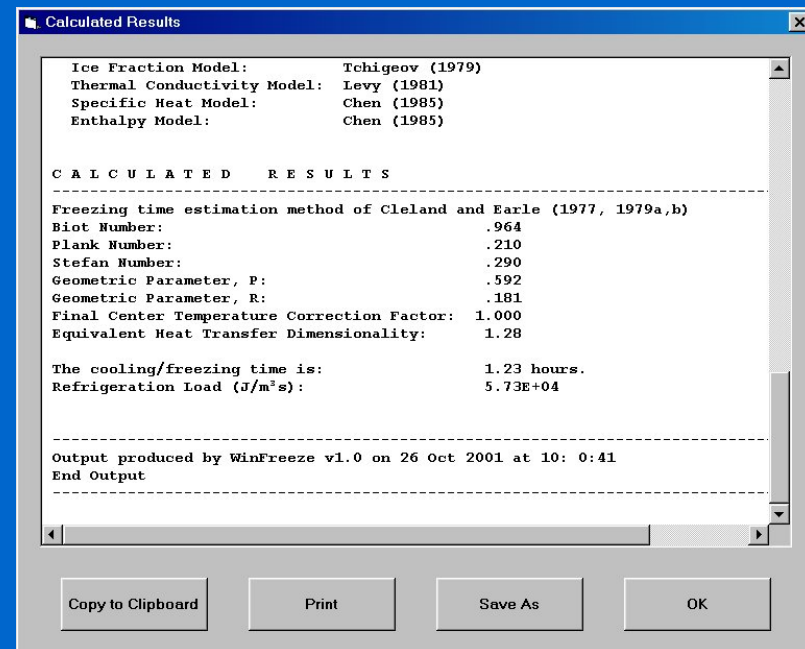
# WinFreeze: Output Data

- Initial and Final Thermophysical Properties
- Freezing/Cooling Time
- Refrigeration Load



# WinFreeze: Output Data

- Initial and Final Thermophysical Properties
- Freezing/Cooling Time
- Refrigeration Load



Calculated Results

Ice Fraction Model: Tchigeov (1979)  
Thermal Conductivity Model: Levy (1981)  
Specific Heat Model: Chen (1985)  
Enthalpy Model: Chen (1985)

C A L C U L A T E D R E S U L T S

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Freezing time estimation method of Cleland and Earle (1977, 1979a,b)  
Biot Number: .964  
Plank Number: .210  
Stefan Number: .290  
Geometric Parameter, P: .592  
Geometric Parameter, R: .181  
Final Center Temperature Correction Factor: 1.000  
Equivalent Heat Transfer Dimensionality: 1.28

The cooling/freezing time is: 1.23 hours.  
Refrigeration Load (J/m<sup>2</sup>s): 5.73E+04

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Output produced by WinFreeze v1.0 on 26 Oct 2001 at 10: 0:41  
End output  
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## Thermophysical Properties Calculator (TPC)

- Determine Food Thermophysical Properties as a Function of Temperature
- Density, Thermal Conductivity, Specific Heat Capacity, Specific Enthalpy, Ice Fraction

# TPC: Input Data

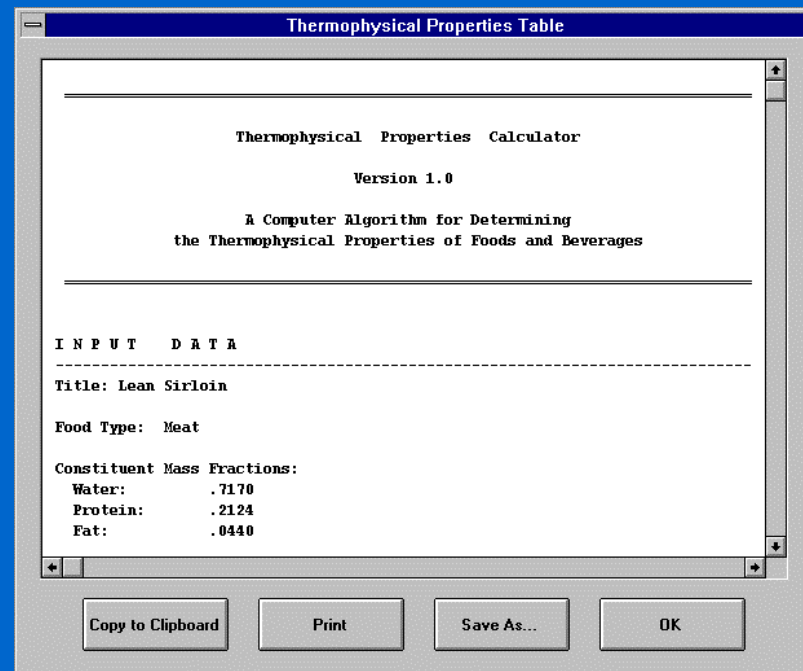
- Food Composition Data
- Initial Freezing Temperature
- Temperature Range for Calculated Properties

The screenshot displays the 'Thermophysical Properties Calculator' software window. The interface is organized into several sections:

- Name of Food Item:** A text input field labeled 'Name:' is currently empty.
- Composition Data:** A section containing several input fields and a dropdown menu:
  - Food Type:** A dropdown menu with 'Meat' selected.
  - Water Content (mass fraction):** An empty input field.
  - Protein Content (mass fraction):** An empty input field.
  - Fat Content (mass fraction):** An empty input field.
  - Carbohydrate Content (mass fraction):** An empty input field.
  - Fiber Content (mass fraction):** An empty input field.
  - Ash Content (mass fraction):** An empty input field.
  - Initial Freezing Temperature (°C):** An empty input field.
- Table Settings:** A section with three input fields:
  - Table Range:** A label for the following two fields.
  - Low (°C):** An input field containing the value '-40'.
  - High (°C):** An input field containing the value '40'.
  - Step Size (°C):** An input field containing the value '5'.
- Buttons:** A vertical stack of four buttons on the right side: 'Advanced . . .', 'Calculate', 'View Property Table', and 'Exit'.

# TPC: Output Data

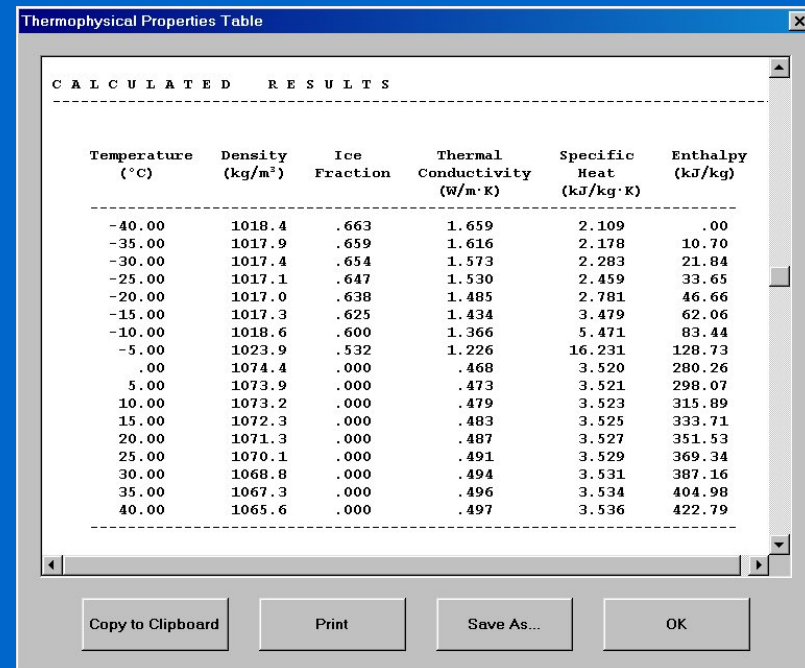
- Thermophysical Properties as a Function of Temperature





# TPC: Output Data

- Thermophysical Properties as a Function of Temperature



Thermophysical Properties Table

C A L C U L A T E D   R E S U L T S

| Temperature<br>(°C) | Density<br>(kg/m <sup>3</sup> ) | Ice<br>Fraction | Thermal<br>Conductivity<br>(W/m·K) | Specific<br>Heat<br>(kJ/kg·K) | Enthalpy<br>(kJ/kg) |
|---------------------|---------------------------------|-----------------|------------------------------------|-------------------------------|---------------------|
| -40.00              | 1018.4                          | .663            | 1.659                              | 2.109                         | .00                 |
| -35.00              | 1017.9                          | .659            | 1.616                              | 2.178                         | 10.70               |
| -30.00              | 1017.4                          | .654            | 1.573                              | 2.283                         | 21.84               |
| -25.00              | 1017.1                          | .647            | 1.530                              | 2.459                         | 33.65               |
| -20.00              | 1017.0                          | .638            | 1.485                              | 2.781                         | 46.66               |
| -15.00              | 1017.3                          | .625            | 1.434                              | 3.479                         | 62.06               |
| -10.00              | 1018.6                          | .600            | 1.366                              | 5.471                         | 83.44               |
| -5.00               | 1023.9                          | .532            | 1.226                              | 16.231                        | 128.73              |
| .00                 | 1074.4                          | .000            | .468                               | 3.520                         | 280.26              |
| 5.00                | 1073.9                          | .000            | .473                               | 3.521                         | 298.07              |
| 10.00               | 1073.2                          | .000            | .479                               | 3.523                         | 315.89              |
| 15.00               | 1072.3                          | .000            | .483                               | 3.525                         | 333.71              |
| 20.00               | 1071.3                          | .000            | .487                               | 3.527                         | 351.53              |
| 25.00               | 1070.1                          | .000            | .491                               | 3.529                         | 369.34              |
| 30.00               | 1068.8                          | .000            | .494                               | 3.531                         | 387.16              |
| 35.00               | 1067.3                          | .000            | .496                               | 3.534                         | 404.98              |
| 40.00               | 1065.6                          | .000            | .497                               | 3.536                         | 422.79              |

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# HydroCool

- Calculate Hydrocooling Times of Fruits and Vegetables

# HydroCool: Data Input

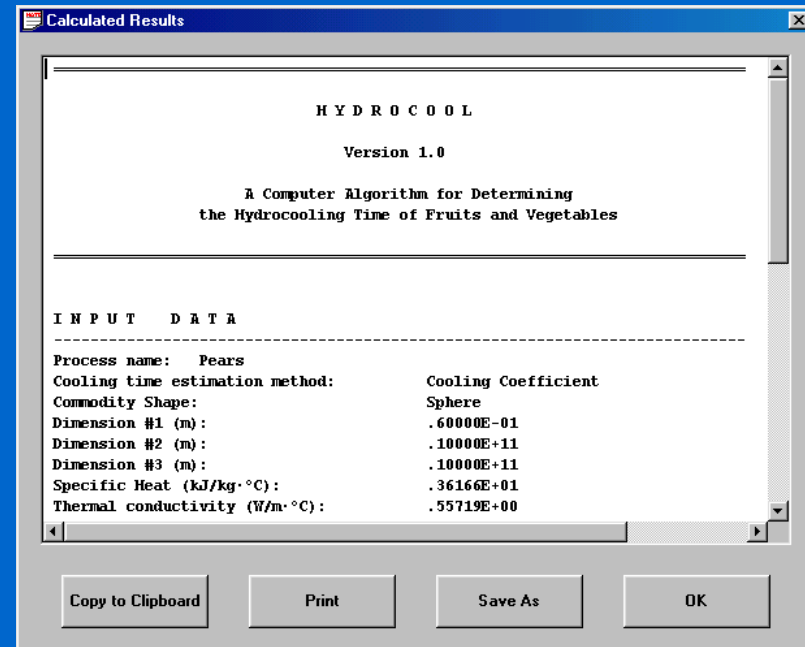
- Initial and Final Commodity Temperature
- Commodity Shape and Dimensions
- Calculation Method
- Hydrocooling Process Parameters

The screenshot displays the HydroCool 1.0 software interface with the following sections:

- Hydrocooling Process Name:** A text input field for "Process Name".
- Commodity Geometry:** A dropdown menu for "Geometry Selection" (set to "Infinite Slab"), and input fields for "Slab Thickness (m)", "Dimension #2, Not Required", and "Dimension #3, Not Required".
- Calculation Method:** Radio buttons for "Half-Cooling Time" (selected), "Cooling Coefficient", "f and j Factors", "EHTD Method", and "Analytic Method".
- Hydrocooling Process Parameters:** Input fields for "Initial Commodity Temperature (°C)", "Final Commodity Temperature (°C)", "Hydrocooling Medium Temperature (°C)", and "Half-Cooling Time (s)".
- Thermophysical Properties of the Commodity:** Input fields for "Thermal Conductivity [W/(m °C)]", "Specific Heat [kJ/(kg °C)]", and "Density (kg/m³)".
- Buttons:** "Calculate", "View Results", and "Exit".

# HydroCool: Output Data

- Commodity Thermophysical Properties
- Hydrocooling Time



The screenshot shows a window titled "Calculated Results" with a text area containing the following text:

```
HYDROCOOL
Version 1.0
A Computer Algorithm for Determining
the Hydrocooling Time of Fruits and Vegetables
```

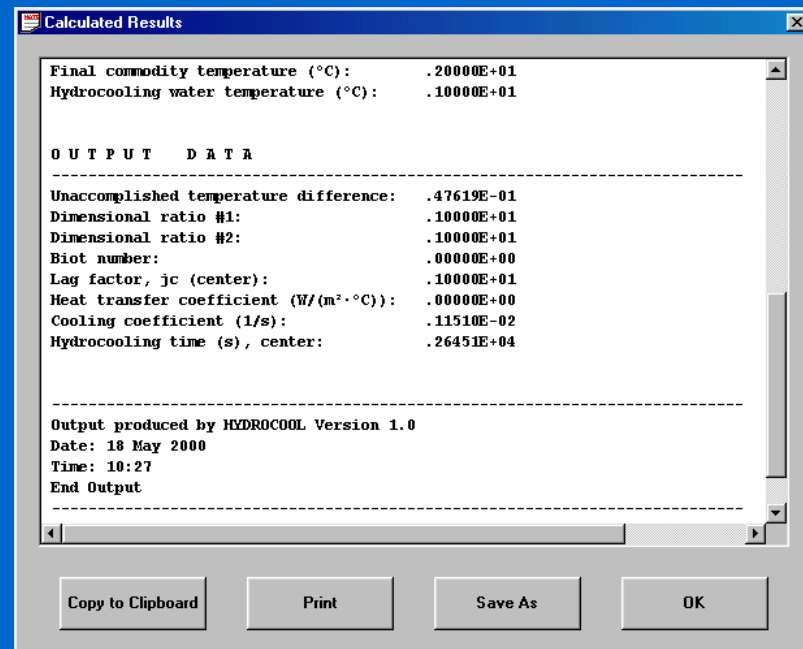
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```
INPUT DATA
-----
Process name: Pears
Cooling time estimation method: Cooling Coefficient
Commodity Shape: Sphere
Dimension #1 (m): .60000E-01
Dimension #2 (m): .10000E+11
Dimension #3 (m): .10000E+11
Specific Heat (kJ/kg·°C): .36166E+01
Thermal conductivity (W/m·°C): .55719E+00
```

At the bottom of the window, there are four buttons: "Copy to Clipboard", "Print", "Save As", and "OK".

# HydroCool: Output Data

- Commodity Thermophysical Properties
- Hydrocooling Time



```
Calculated Results
Final commodity temperature (°C): .2000E+01
Hydrocooling water temperature (°C): .1000E+01

O U T P U T   D A T A
-----
Unaccomplished temperature difference: .47619E-01
Dimensional ratio #1: .1000E+01
Dimensional ratio #2: .1000E+01
Biot number: .0000E+00
Lag factor, jc (center): .1000E+01
Heat transfer coefficient (W/(m²·°C)): .0000E+00
Cooling coefficient (1/s): .11510E-02
Hydrocooling time (s), center: .26451E+04

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Output produced by HYDROCOOL Version 1.0
Date: 18 May 2000
Time: 10:27
End Output
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Copy to Clipboard  Print  Save As  OK
```