MINUTES
of the
YANKEE DRYER SAFETY COMMITTEE
April 26, 2006
8:11 AM EDT
Marriott Hotel
Atlanta, GA

Present:

Brian Tholke – Procter & Gamble Co
Peter Costello – Kimberly-Clark Corp.
Colin Archibald – Scott Paper Ltd.
Jörg Bauböck – Andritz
Joseph Schulz (rep. William Burns) – Georgia Pacific Co
Clive Butler – Sandusky International
Robson Consolato – Voith
Bill Corboy – Yankee Consulting, Inc.
Marcos Scheil Gonçalves – Voith
Daryl Hoffman – FM Global
Magnus Högman – Metso Karlstad
Dwight Hyche – Marsh Risk Consulting
Ted Johnson – Voith Paper
Pekka Kormano – Deublin
John Kriedeman – Metso USA
Larry Ledlow – Hartford Steam & Boiler
Karl Mayer – FM Global
Mike Paczkowski – BTG Americas
Roberto Pardo – Voith
Michael Schindler – Albany, Int'l.
Greg Wedel – Kadant Johnson
Rick Wasson – Ivrving Tissue
Dennis White – Inspection Systems and Services

I. Welcome and Statement of Antitrust Policy Compliance

The regular meeting of the Yankee Dryer Safety Committee was called to order at 8:11 AM EDT on April 26, 2006 in Atlanta, Georgia USA by Chairman Brian Tholke.

Brian Tholke reminded those present that the meeting would be conducted in accordance with TAPPI's Antitrust Policy and Procedures.

TAPPI's aim is to promote research and education, and to arrange for the collection, dissemination and interchange of technical concepts and information in fields of interest to its members. TAPPI is not intended to, and may not, play any role in the competitive decisions of its members or their employers, or in any way restrict competition among companies.

Brain reminded everyone that the heart of this committee is all about technology transfer in order to ensure the safe operation of Yankee dryers.

II. Approval of Agenda

The agenda was approved as distributed which included the following:

Virtual Reference Grinding by Tend Johnson
Yankees for High Line Loads by Clive Butler
Recent Yankee Incidents in Europe by Magnus Hogman
NBIC Appendix K Revision by Brian Tholke
Future Topics
Future Committee Activities
Open Discussion

III. Approval of Minutes of the May 24, 2005 meeting.

The minutes of the August 30, 2005 meeting were approved by all. Dennis White made a motion to accept the minutes as read and Mike Paczkowski seconded the motion.

IV. Action Items

There was no action items from the past meeting brought forward. However, it was suggested by Brian Tholke that a Technical Alert Bulletin be drafted regarding the potential cracking of a Yankee dryer that could occur on the inside shell surface as a result of a suction pressure roll cover delamination.

V. Discussion Items

Where permitted by the host company, the presentation from each of the following discussions is attached for your reference:

Virtual Reference Grinding by Tend Johnson
Yankees for High Line Loads by Clive Butler
Recent Yankee Incidents in Europe by Magnus Hogman
NBIC Appendix K Revision by Brian Tholke

VI. New Business

Future Topics for Meeting Presentations:

Plugging of Yankee shells
Alternatives to Hydro testing for in-service evaluation
Interlocks and Controls, Yankee Safety Systems
Recent Yankee incidents
Dryer Cans
Cooling load on Yankee due to showers and sheet

Future Committee Activities

Steam And Condensate Systems
The re-write of the Yankee Safety Guidelines
Yankee dryer safety training using Case Studies or Scenarios – Peter Costello
Development of a Form for reporting dryer incidents
Compile an official list of TAPPI papers from the Yankee Dryer Safety Committee – Brian Tholke
Fitness-For-Service inspection after a major dryer incident
Yankee incident/failure data base update
Review Yankee dryer spares data base – Brian Tholke
Fitness-For Service Inspection for spare dryers – Clive Butler

Open Discussion

Expanding membership and reaching out to smaller mills
Participation in Nice Tissue World conference

VI. Next Meeting

It will be in the Fall of 2006 in Atlanta, GA sometime between November 5-8th. The location, date and time to be announced.

VII Adjournment

There being no further business to come before the Yankee Dryer Safety Committee, the meeting was adjourned at 11:25 AM EDT through a motion by Larry Ledlow and seconded by Rick Wasson.

Minutes submitted by: Peter Costello
Approved by: Veranda Edmondson, TAPPI Member Group Specialist

Attachments:
PDF file – Virtual Reference Grinding by Tend Johnson
PDF file – Yankees for High Line Loads by Clive Butler
PDF file – Recent Yankee Incidents in Europe by Magnus Högman
PDF file – NBIC Appendix K Revision by Brian Tholke Recent Dryer Failure

Sandusky Walmsley Limited

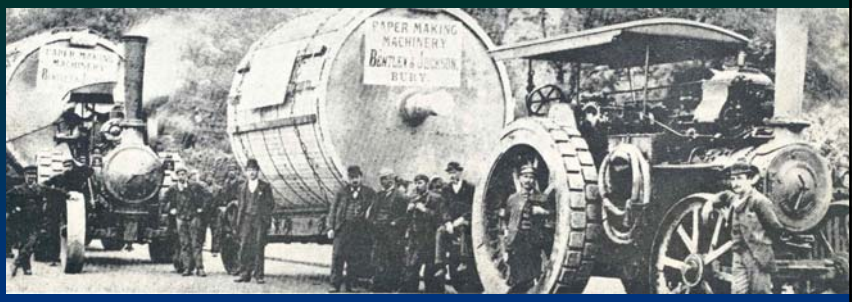
Yankee Dryers for High Press Loads

April 2006

By

Clive Butler

100 Years of Yankee Dryers



"I want a Yankee dryer that is bigger, wider, faster and more productive"

A. Tissuemaker

Modern Yankee Dryers

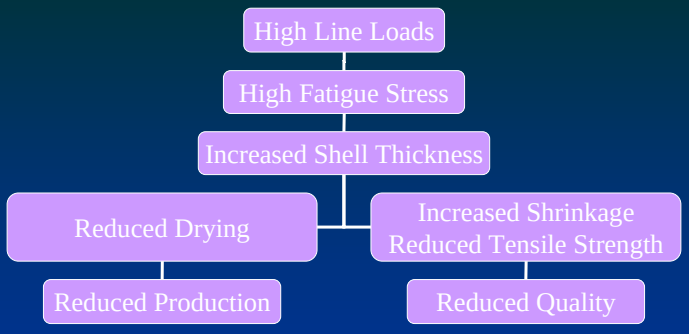
Today's Yankee Dryers are bigger, wider, faster and because they are ribbed and higher pressure, more productive

A New Challenge

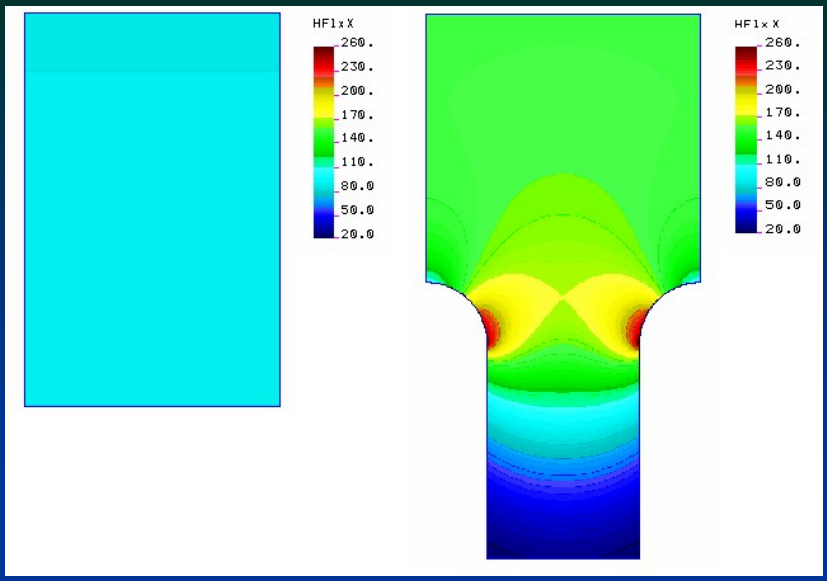
"I want a Yankee dryer that can operate with a 170kN/m external line load but it must still give the same amount of drying as a conventional Yankee dryer"

A. Tissuemaker

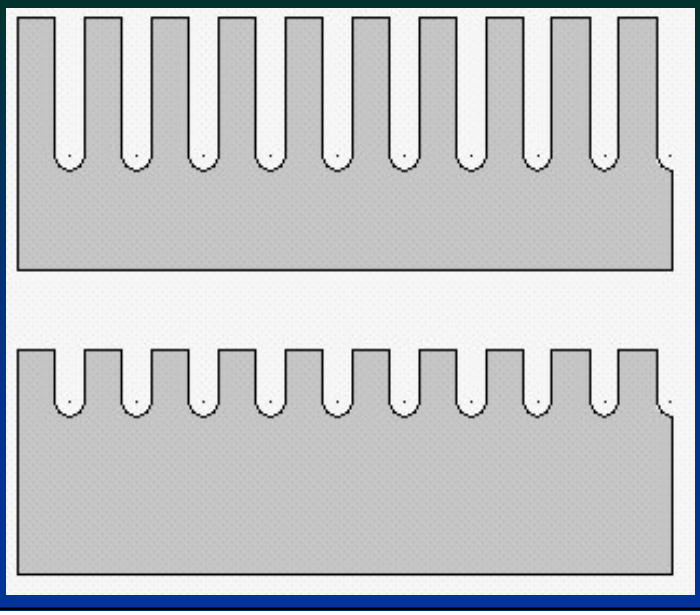
The Problem



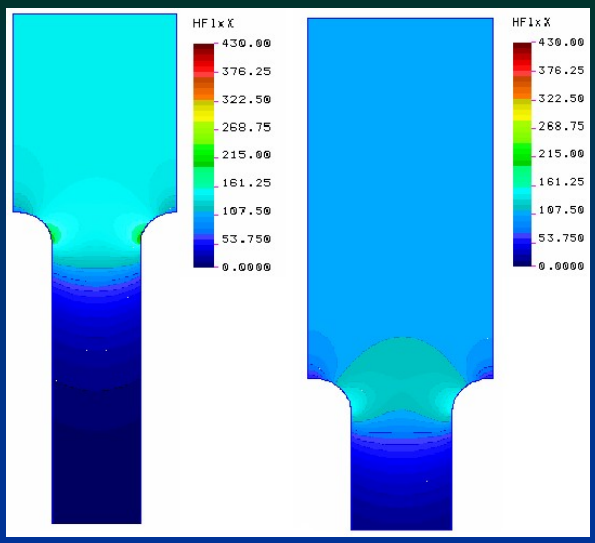
Heat Flow through Yankee Shells



Alternative Design Yankee Shells



Heat Flow through Yankee Shells



Deep rib design 25% better heat transfer

Casting A Thick Shell

- *Now we have a shell design to meet the papermakers needs.*
- *The design is thicker than any Yankee shell ever cast:*

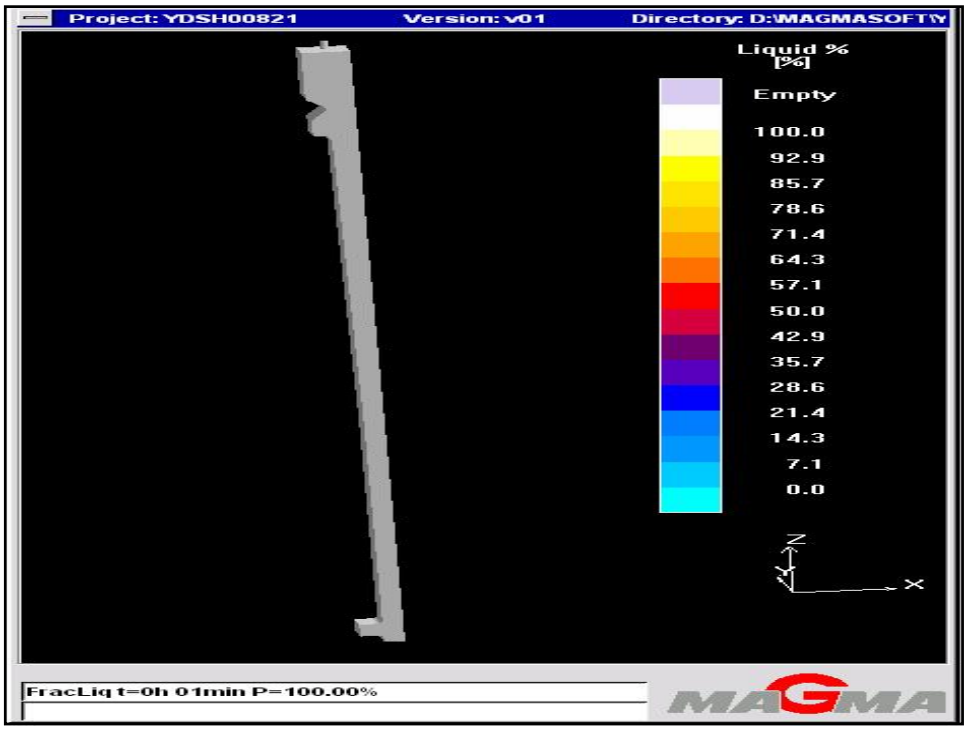
	Cast thickness	Cast weight
Conventional 18ft	102 mm	95 Tonnes
Deep rib 18 ft	154 mm	144 Tonnes

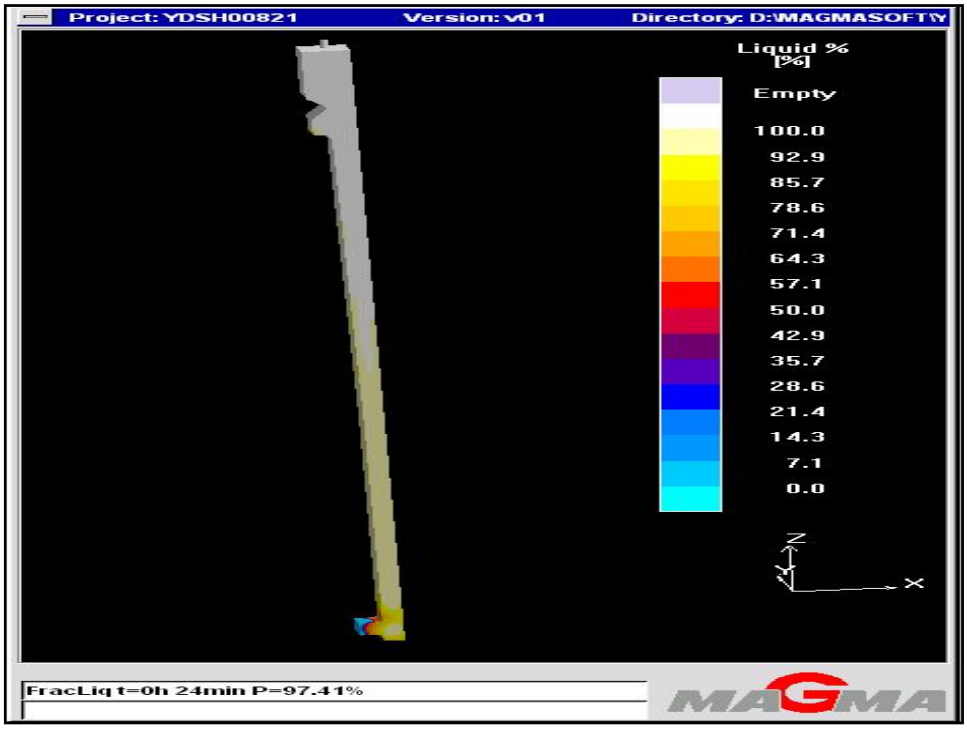
Casting A Thick Shell

- *Over the last 50 years the quality of castings has improved dramatically*
- *Experience and trial and error was the method of improving casting*
- *We cannot afford to experiment on our new design Yankee shells for another 50 years, and thankfully we don't need to because we have an advantage over our predecessors……..*
- ***The computer***

Computer Modelling of a Casting

- *A recent investment in a State of the Art casting software package has given us the chance to experiment without the time and expense of making a casting.*
- *This, in conjunction with our experience, has enabled us to predict the quality of a casting before any metal is pored.*

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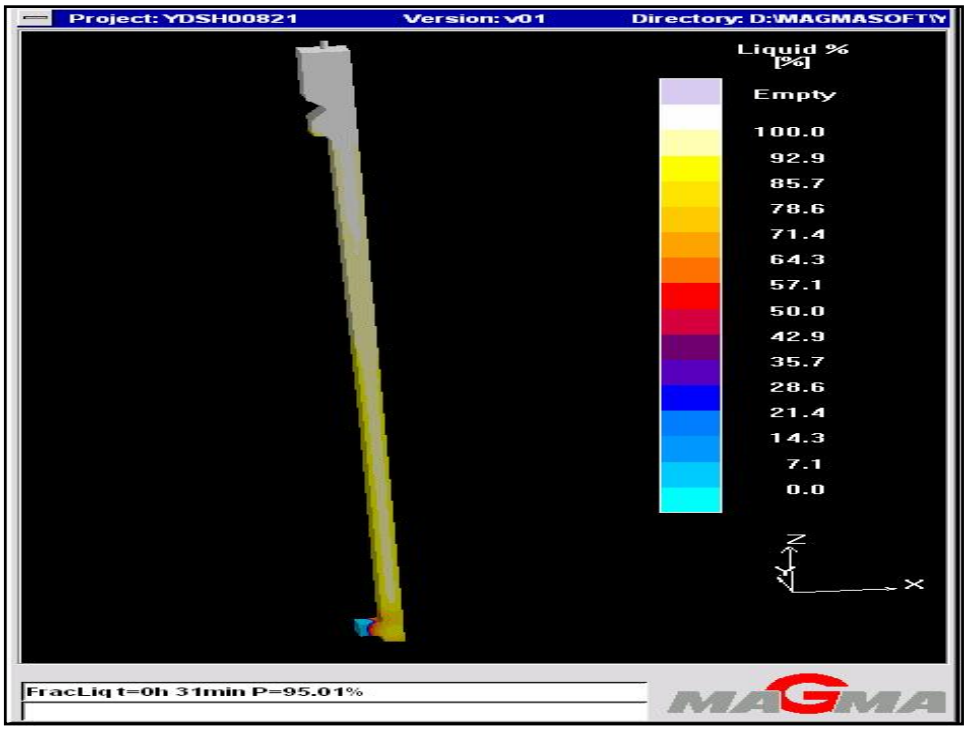
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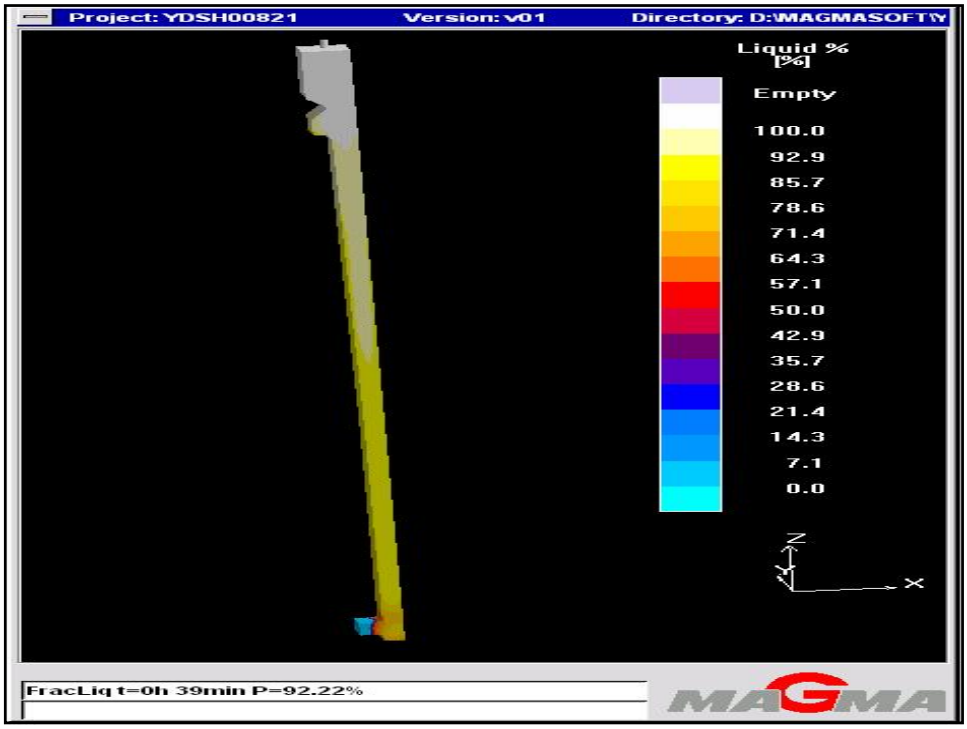
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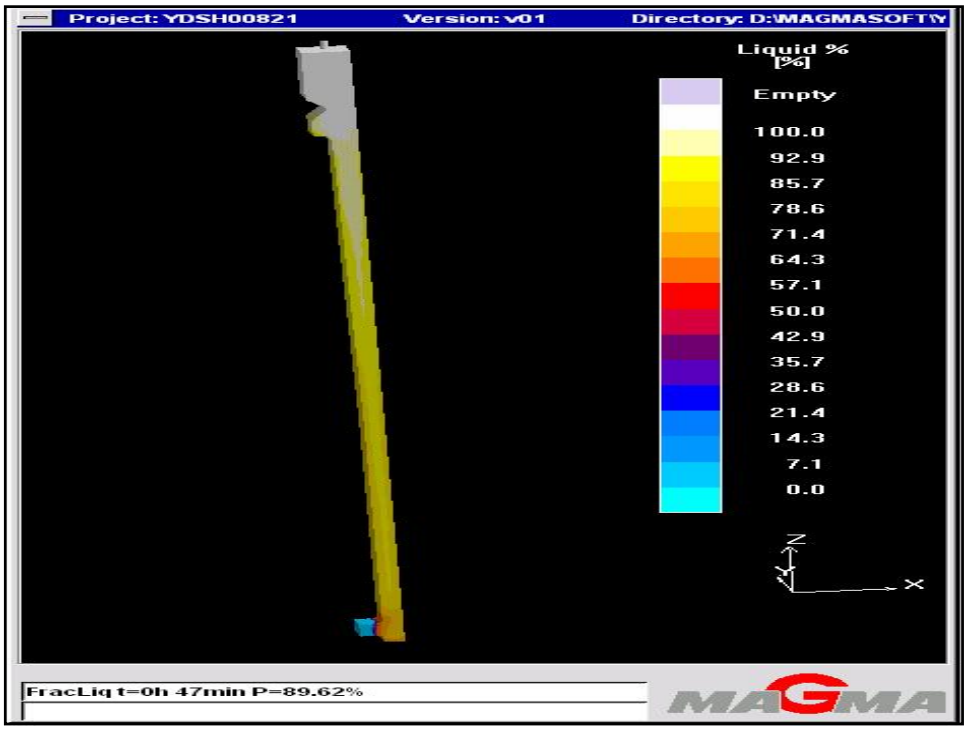
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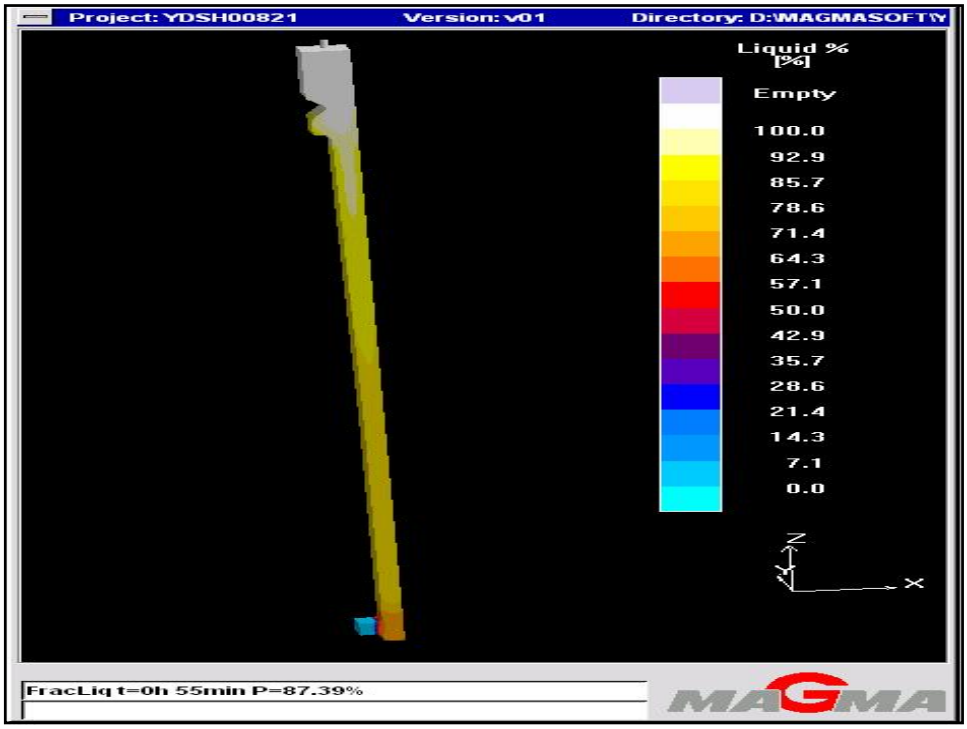
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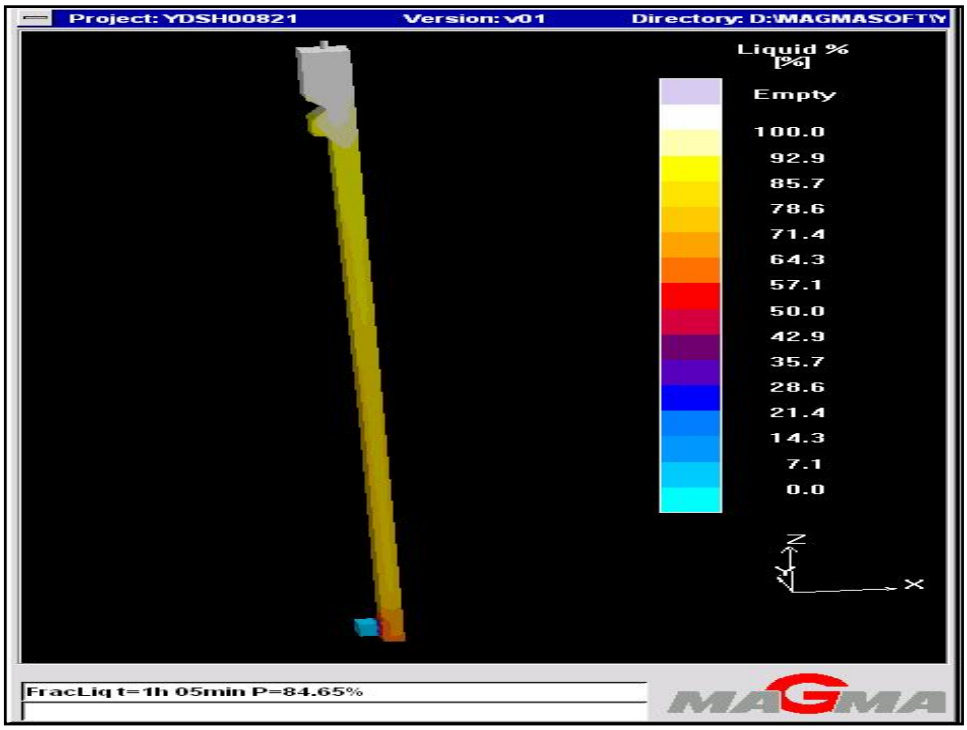
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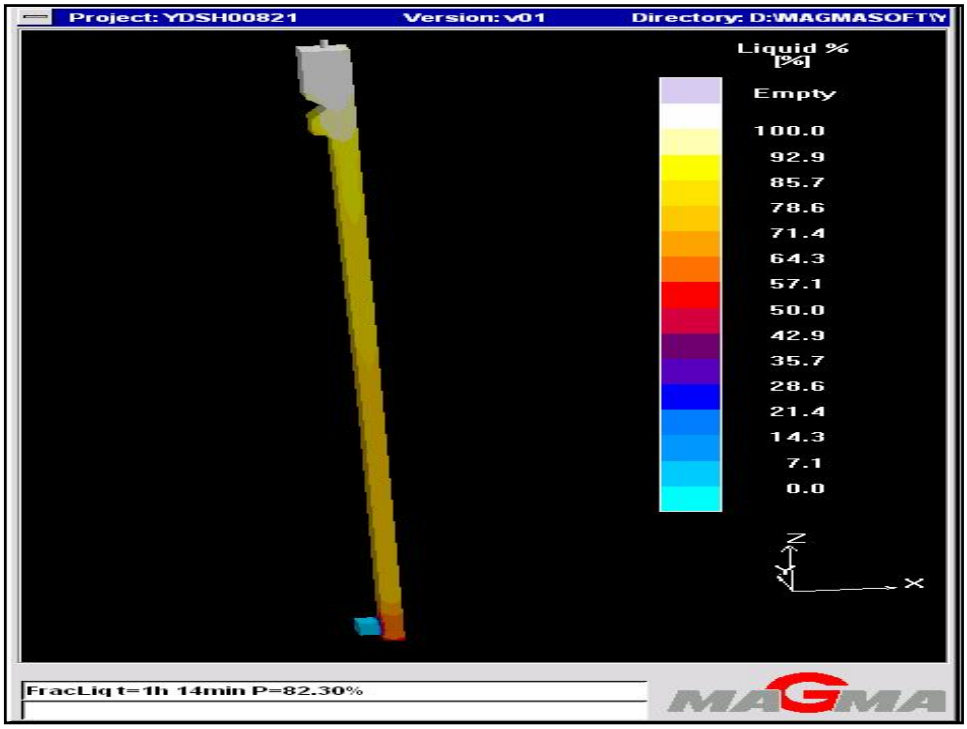
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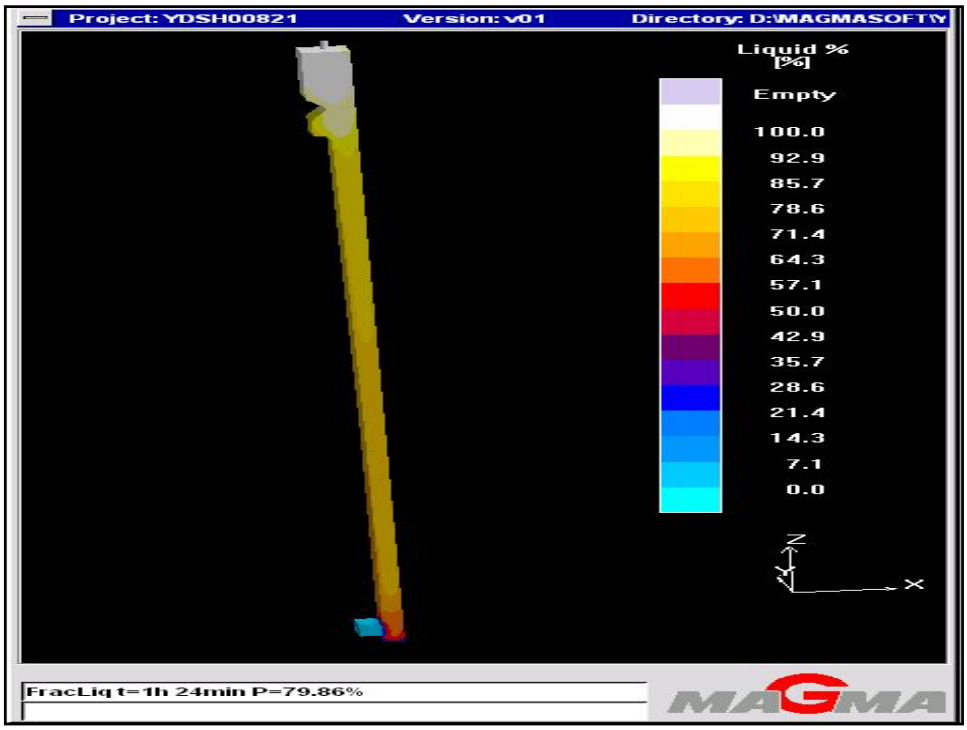
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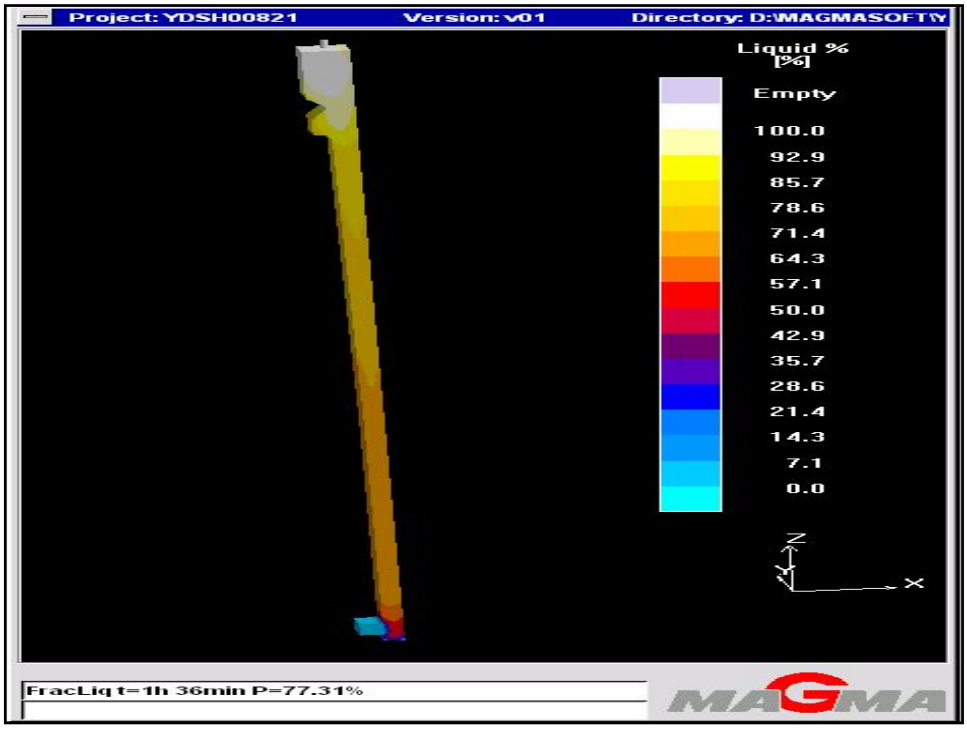
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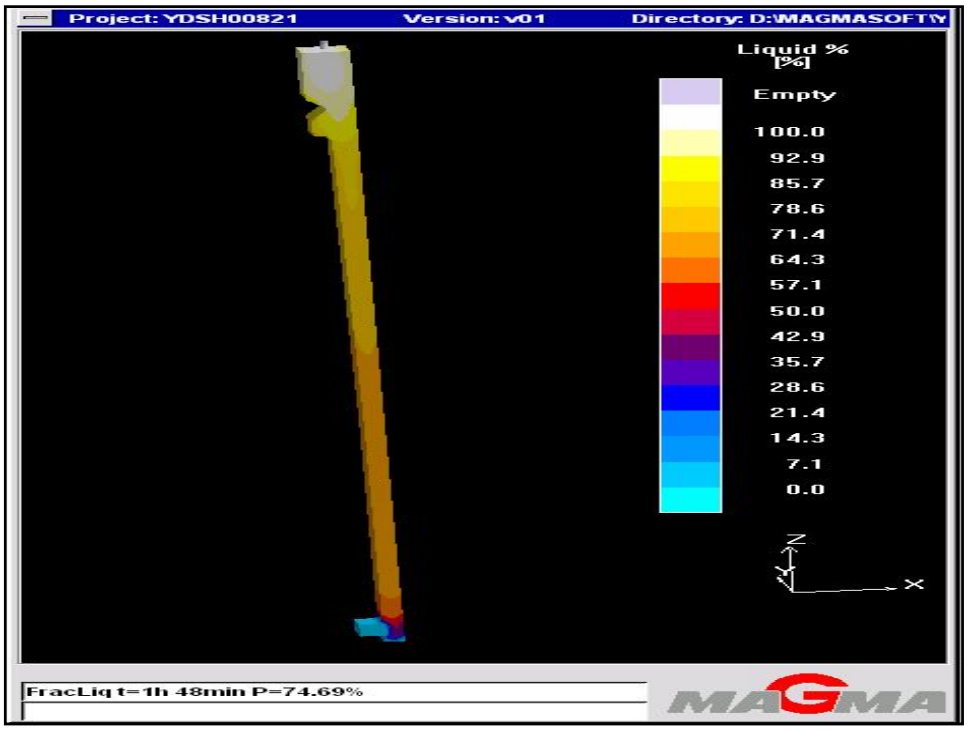
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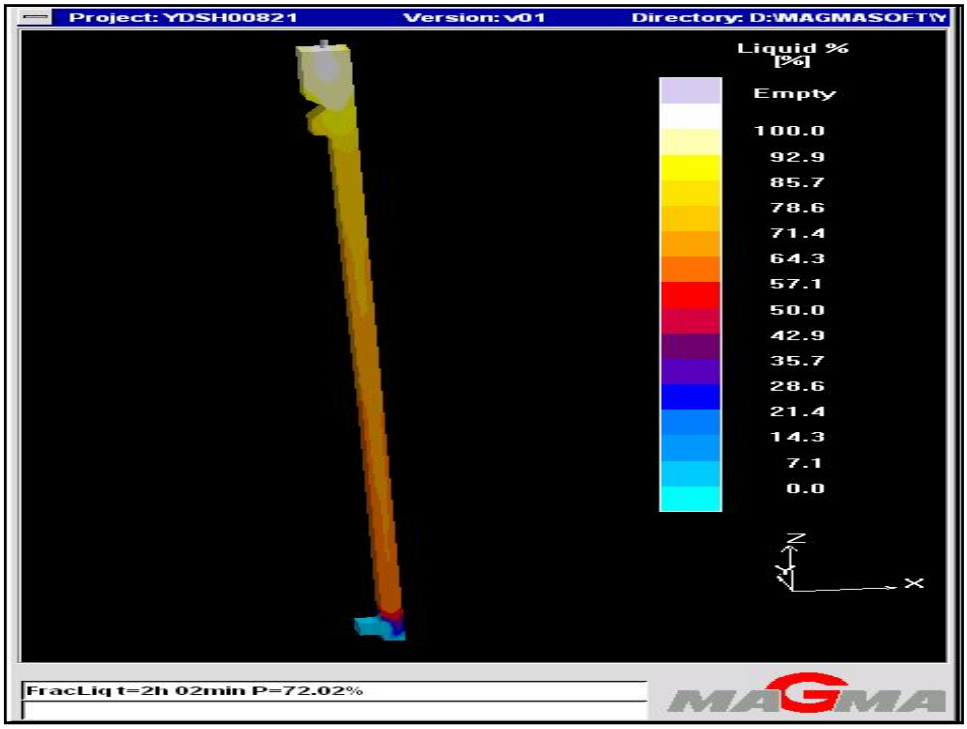
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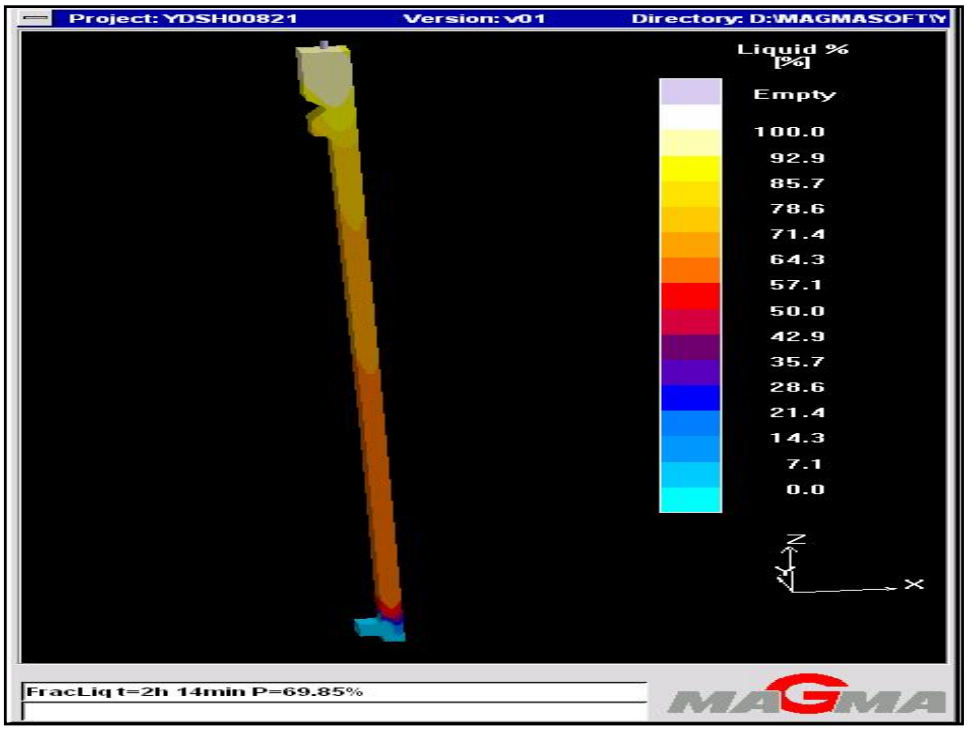
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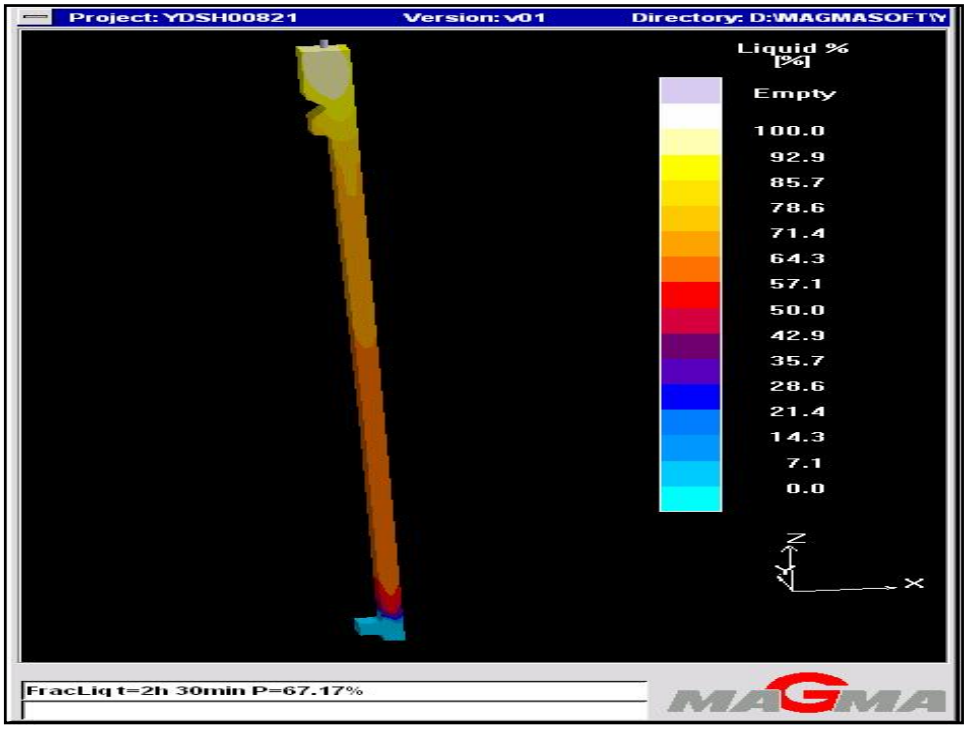
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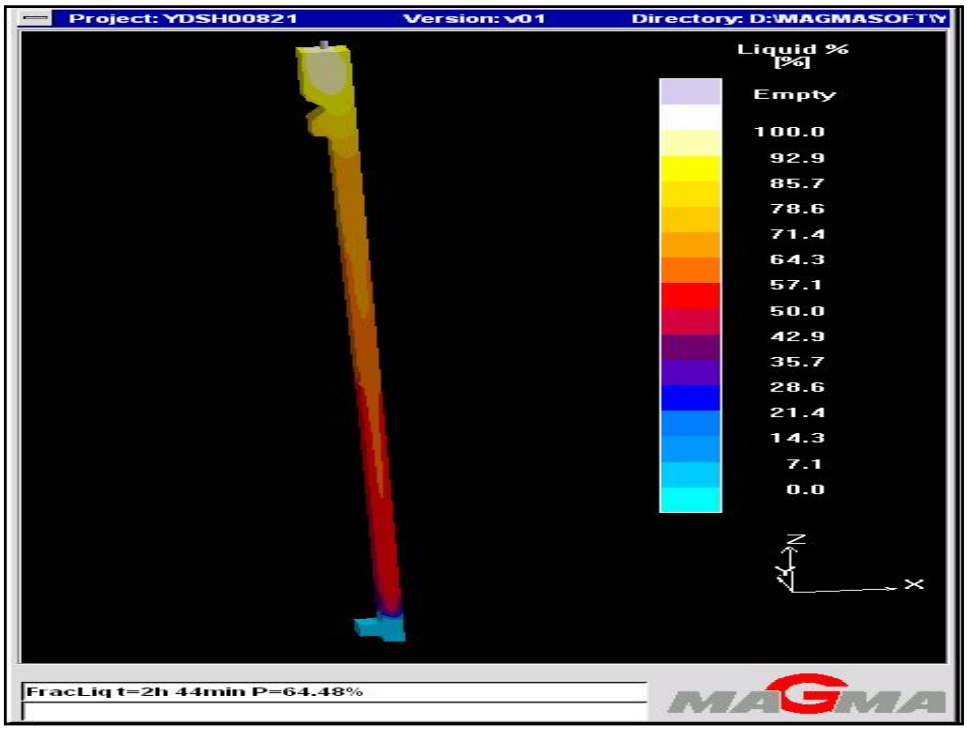
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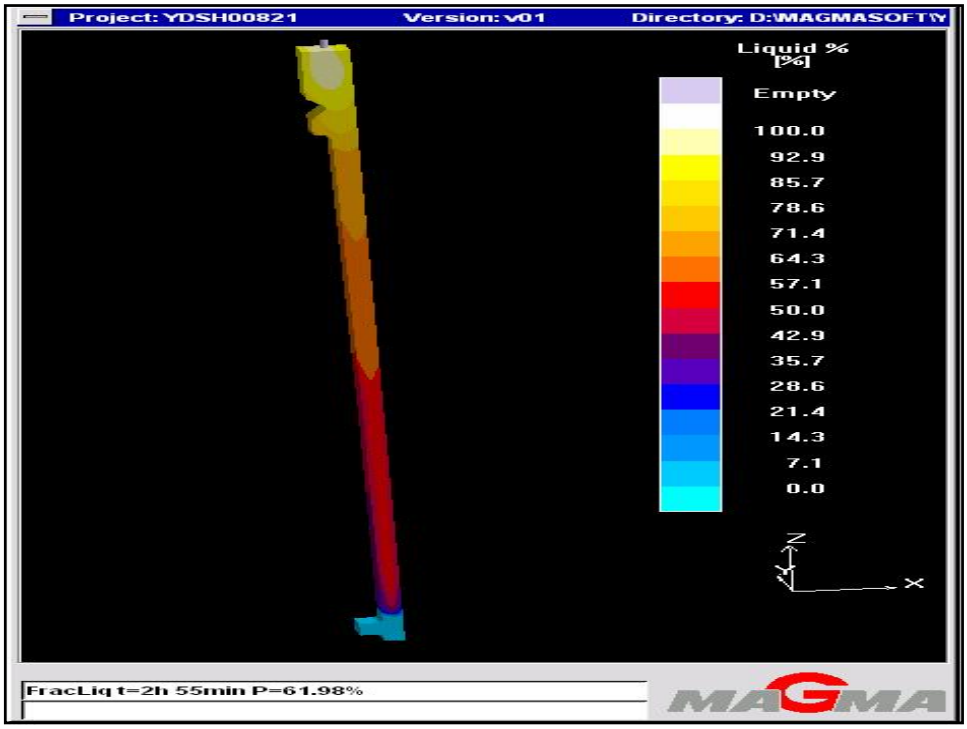
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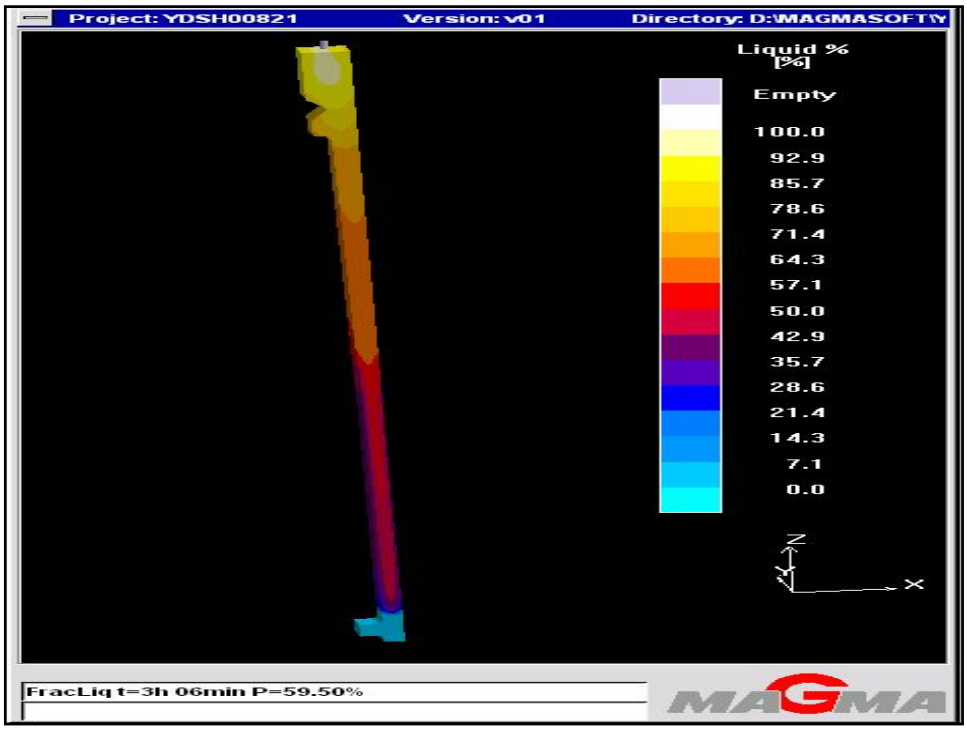
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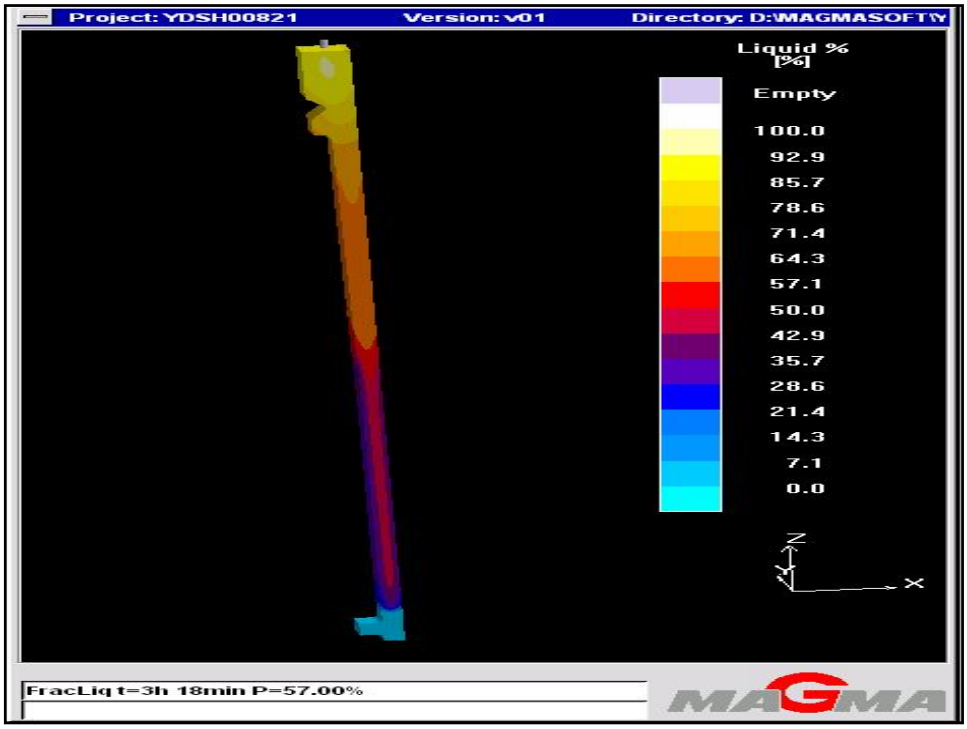
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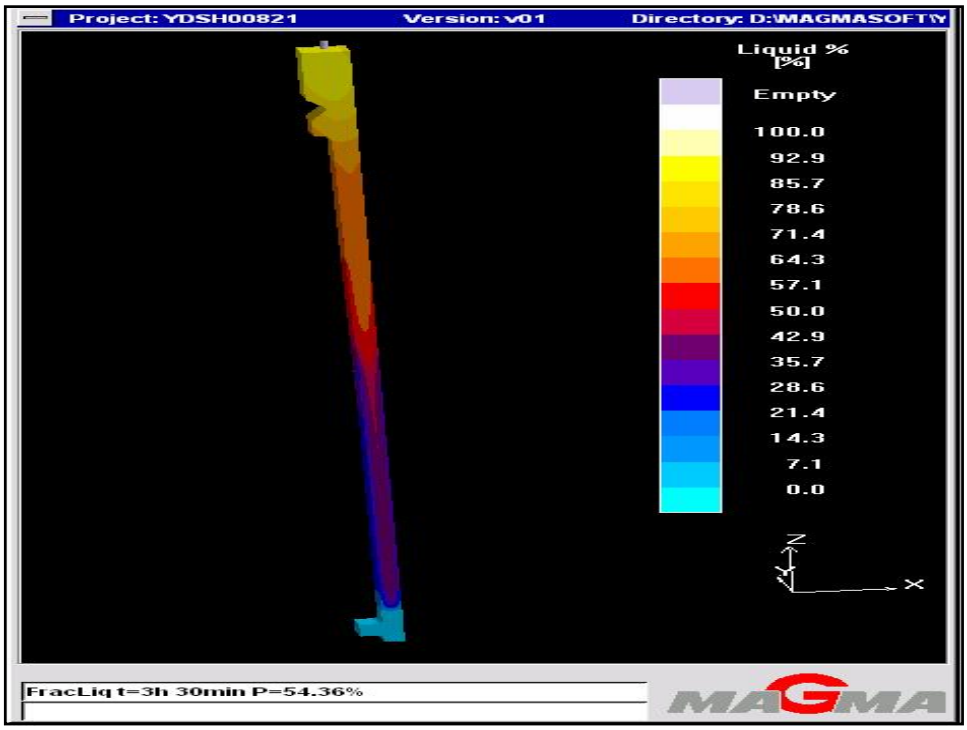
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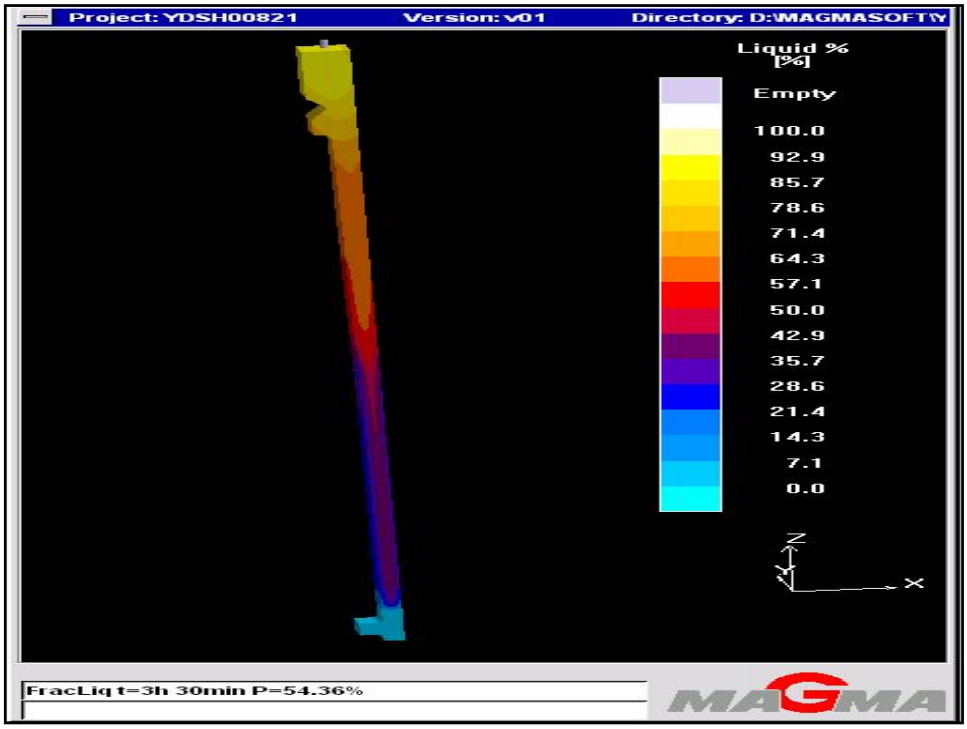
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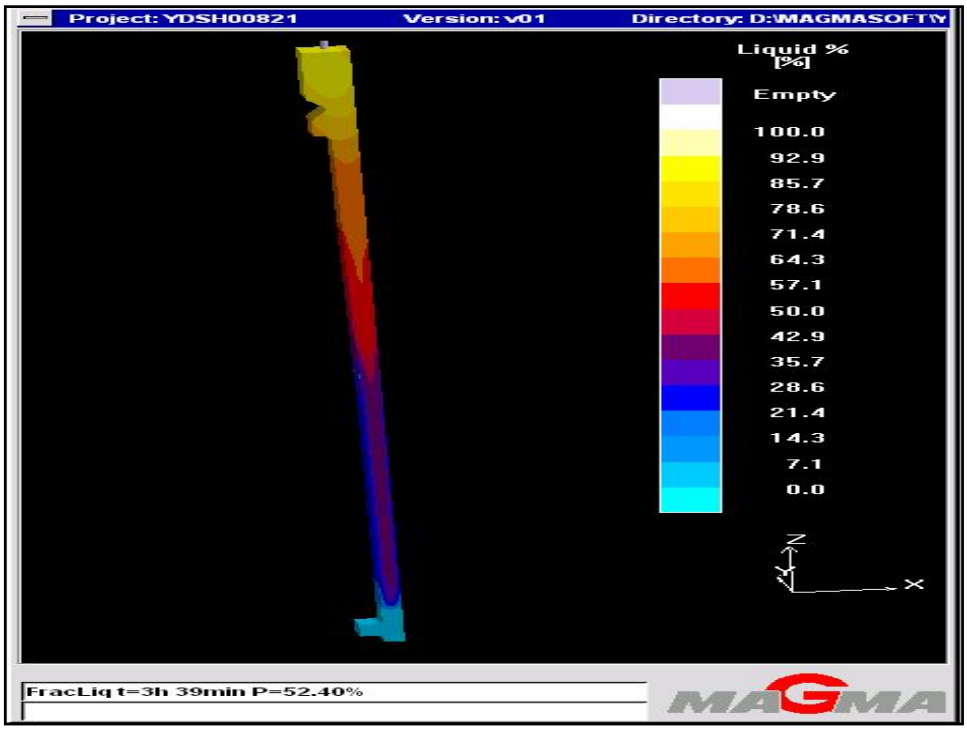
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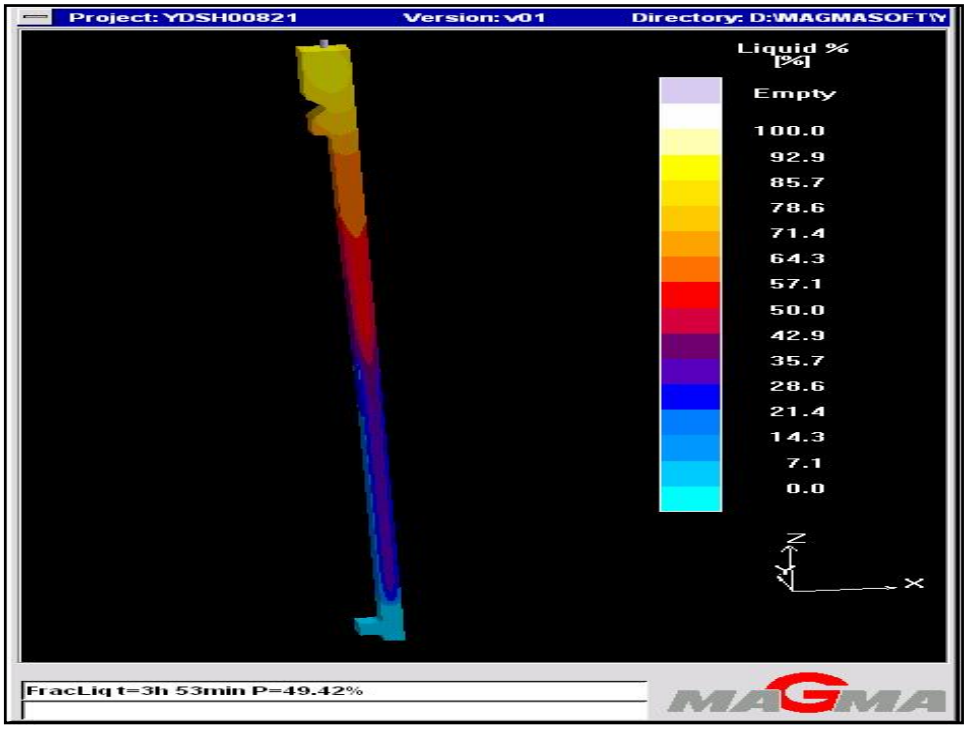
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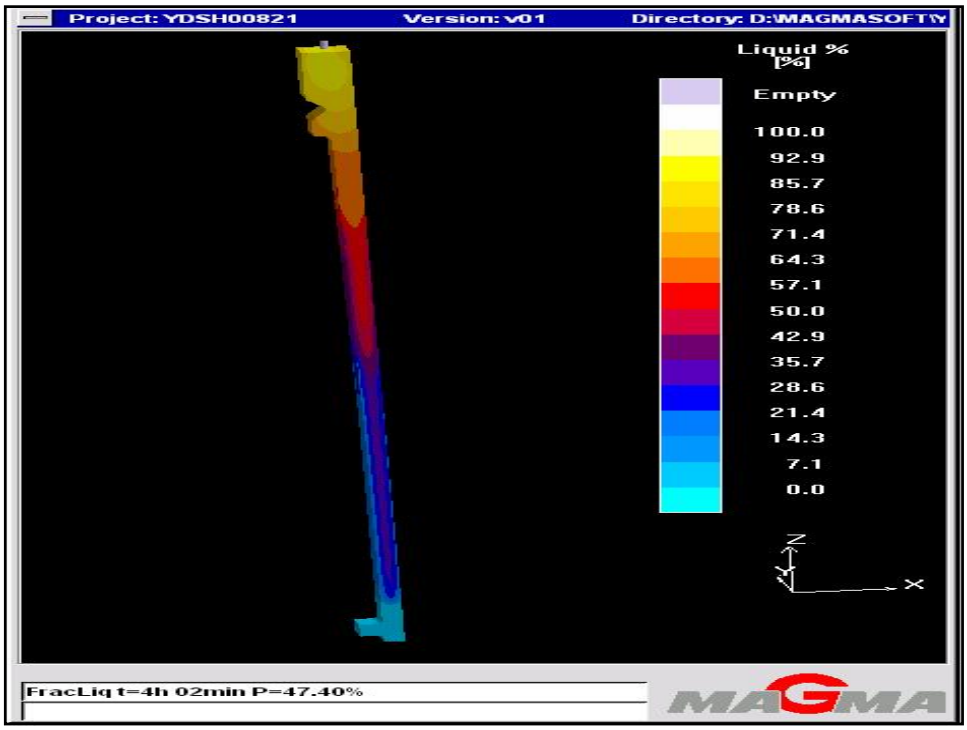
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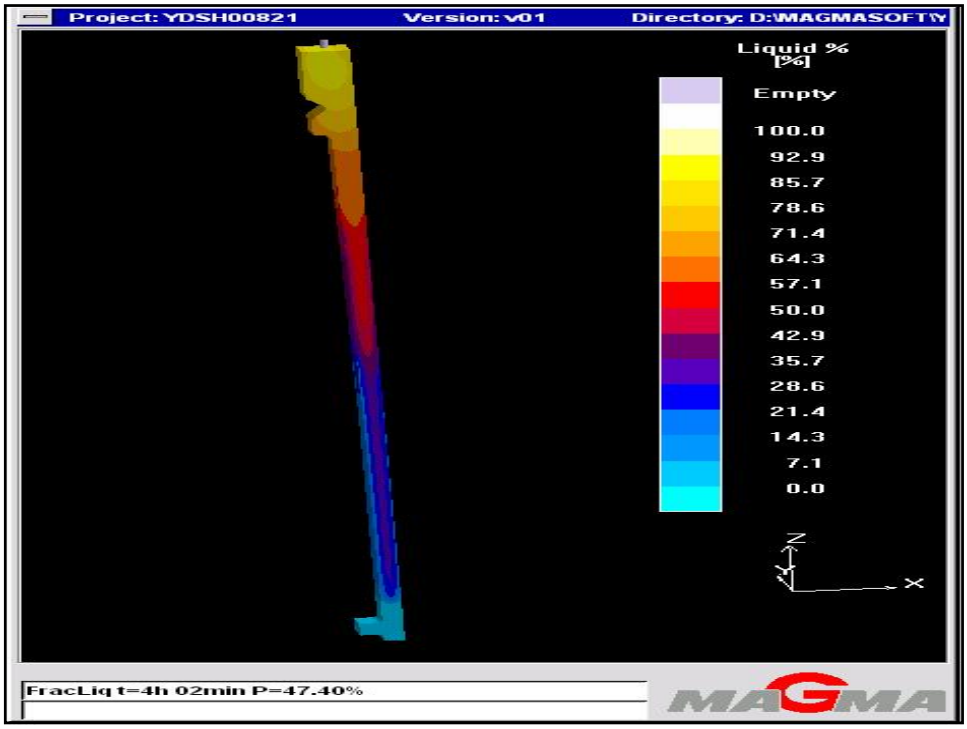
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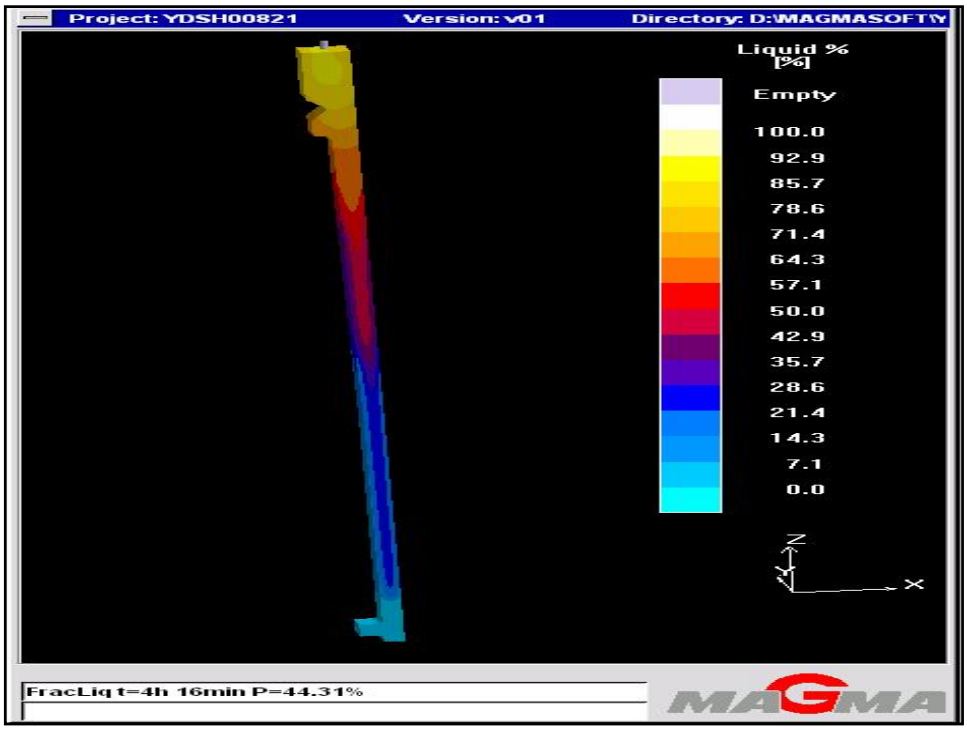
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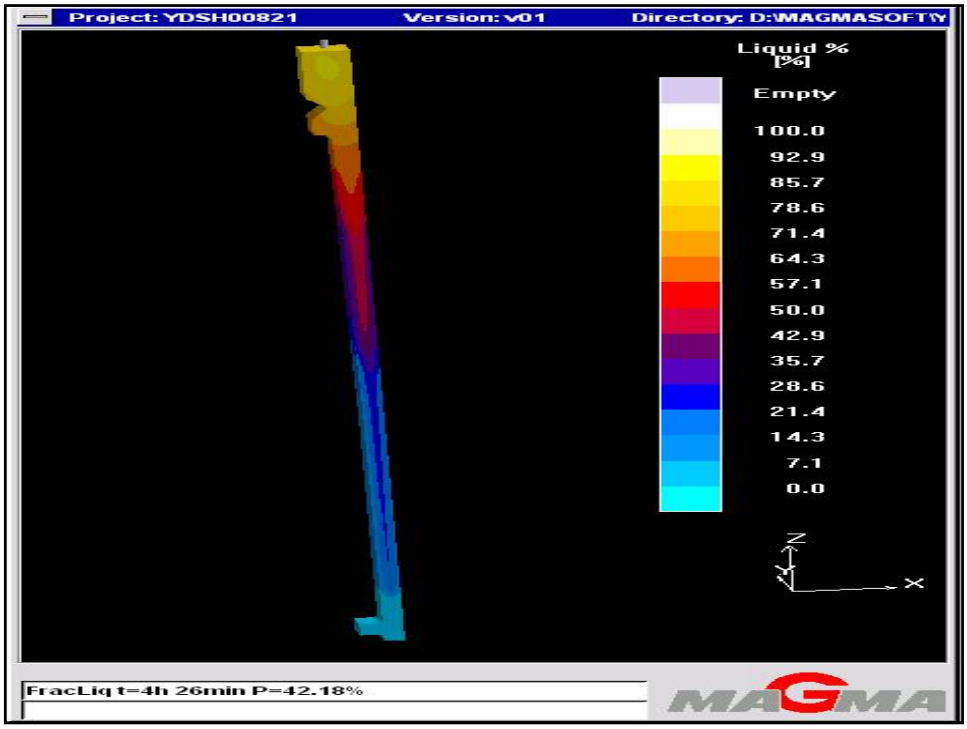
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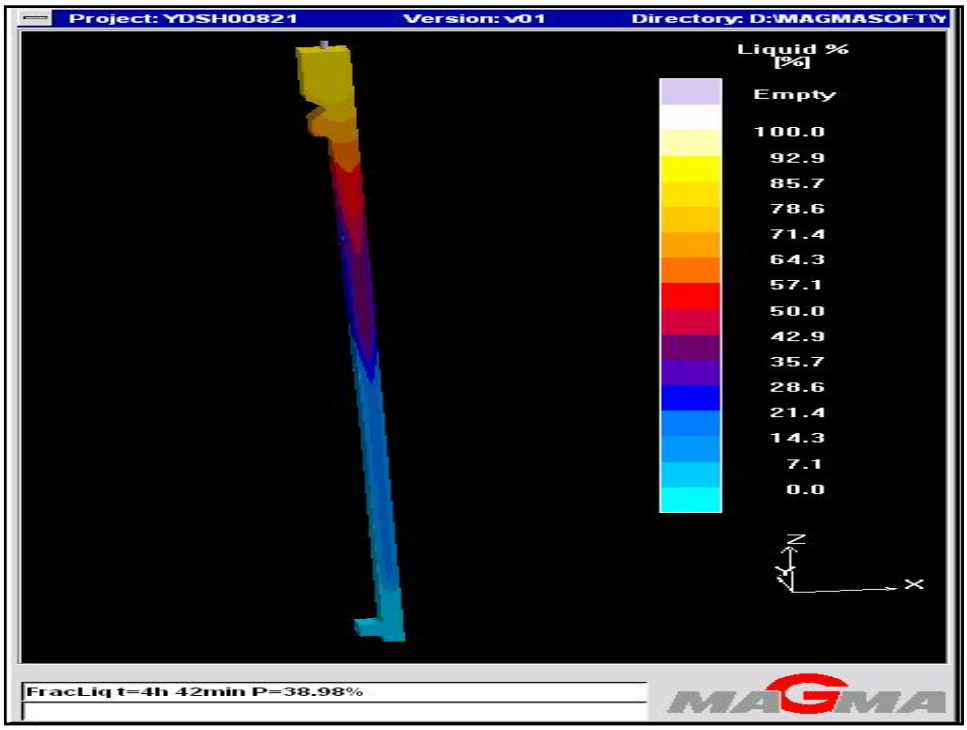
MAGMA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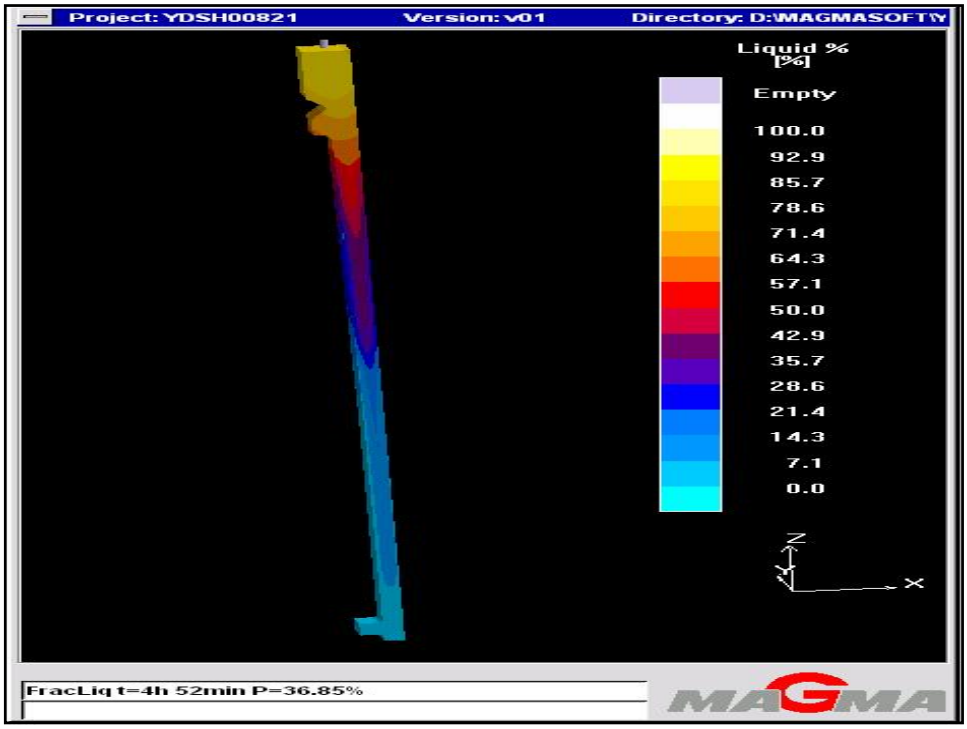
MAGMA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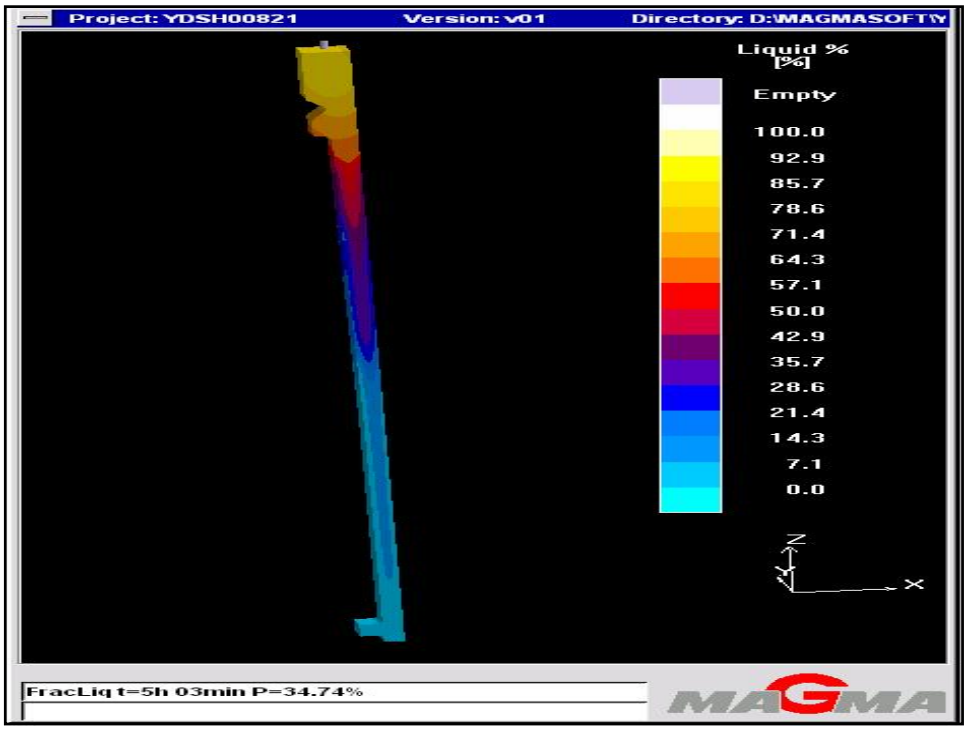
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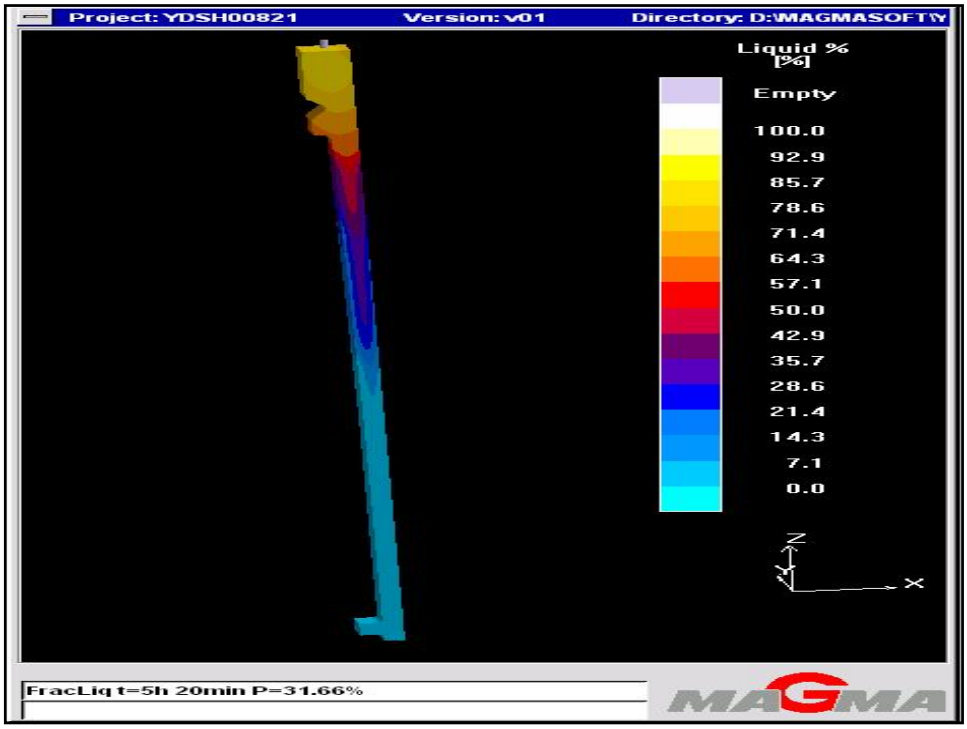
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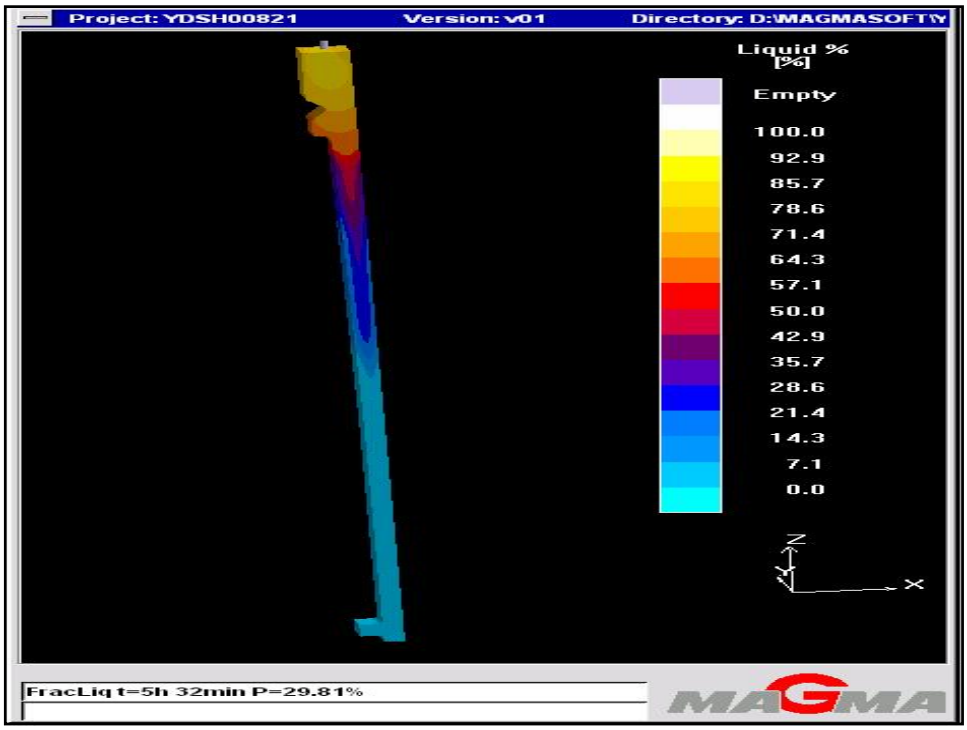
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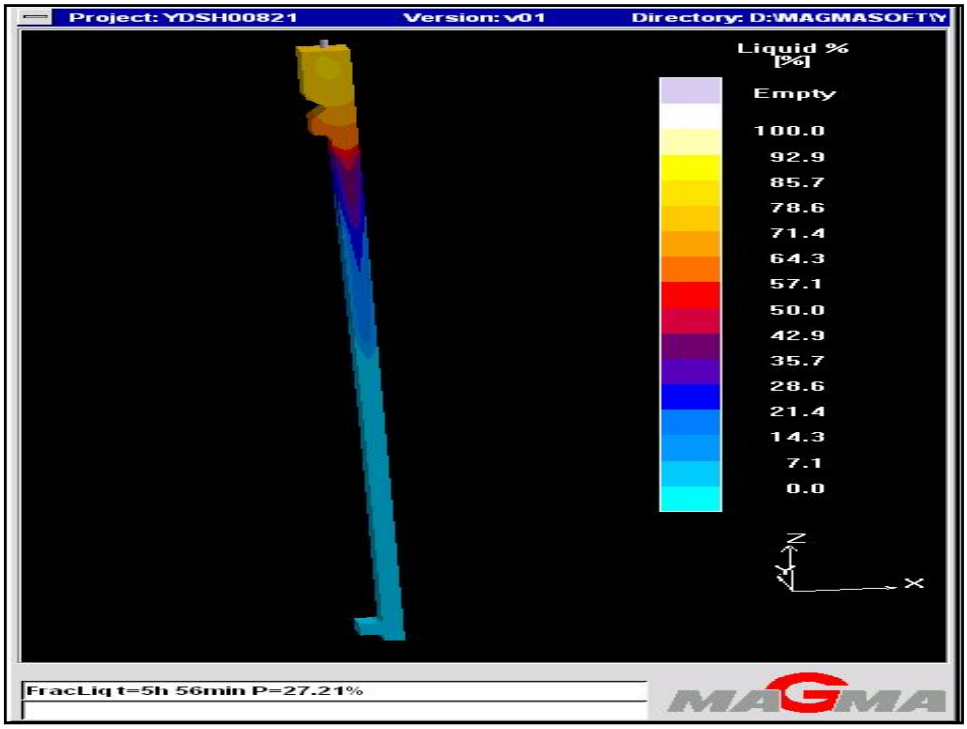
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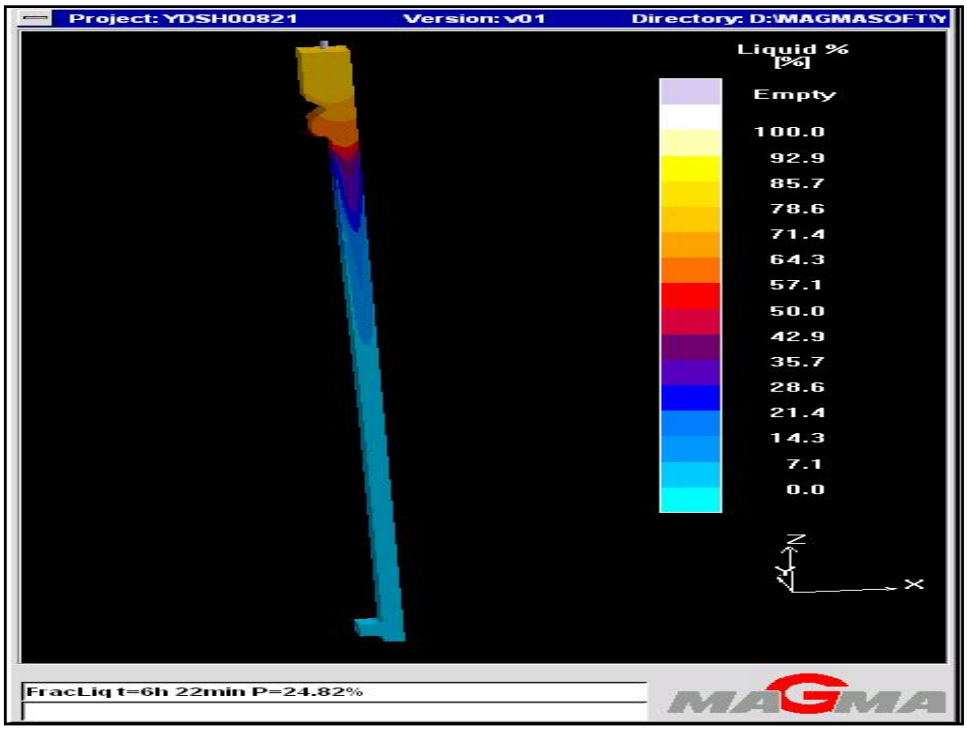
MAGMA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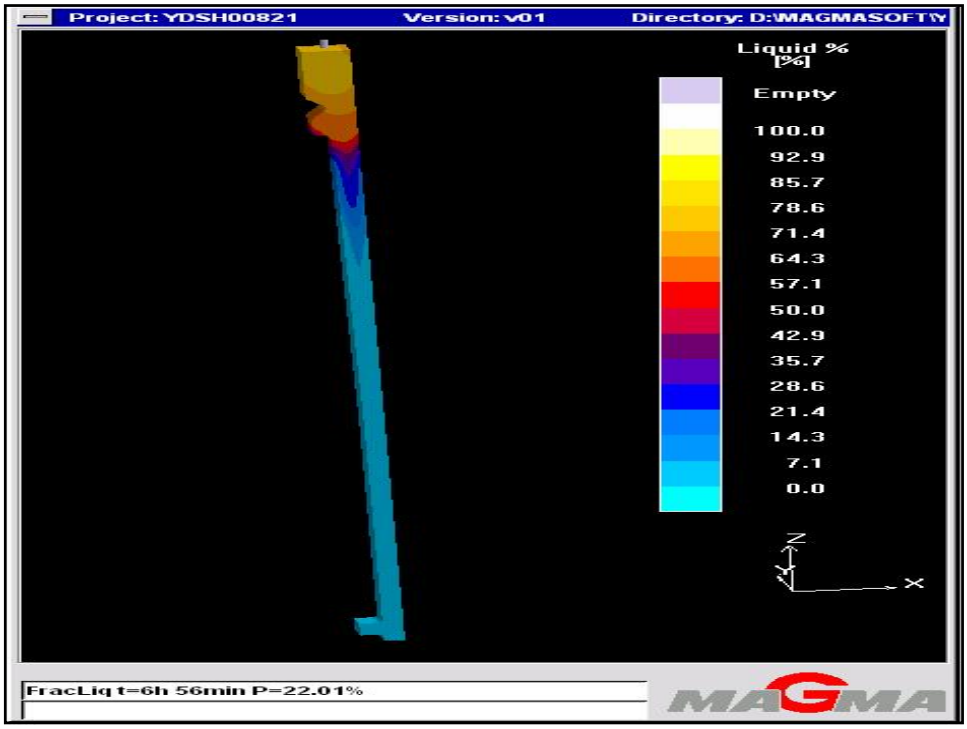
MAGMA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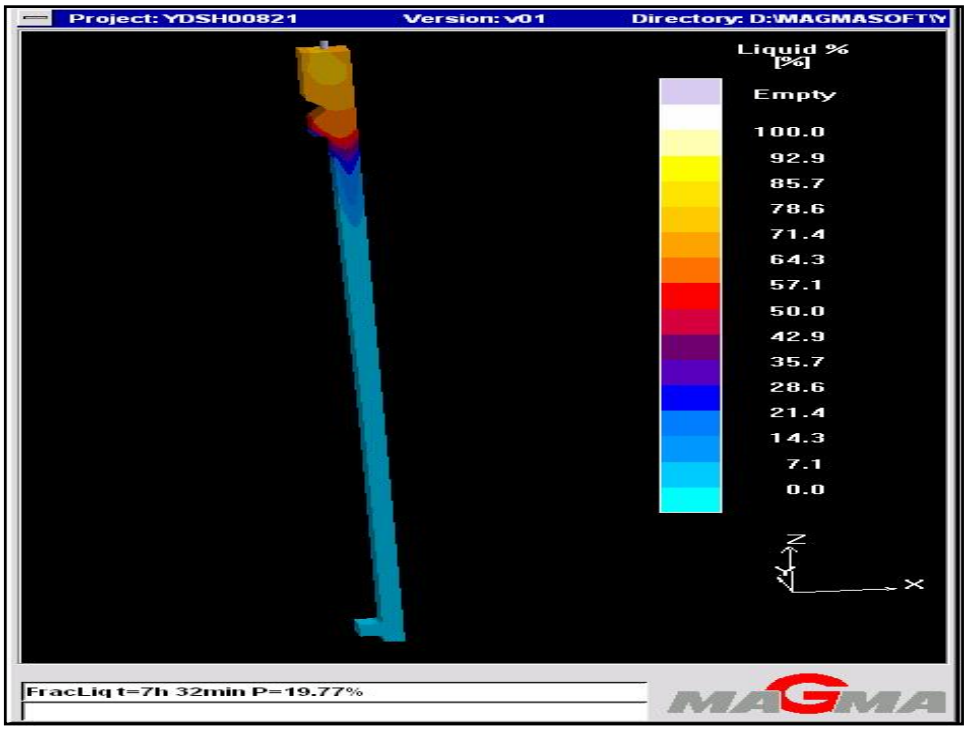
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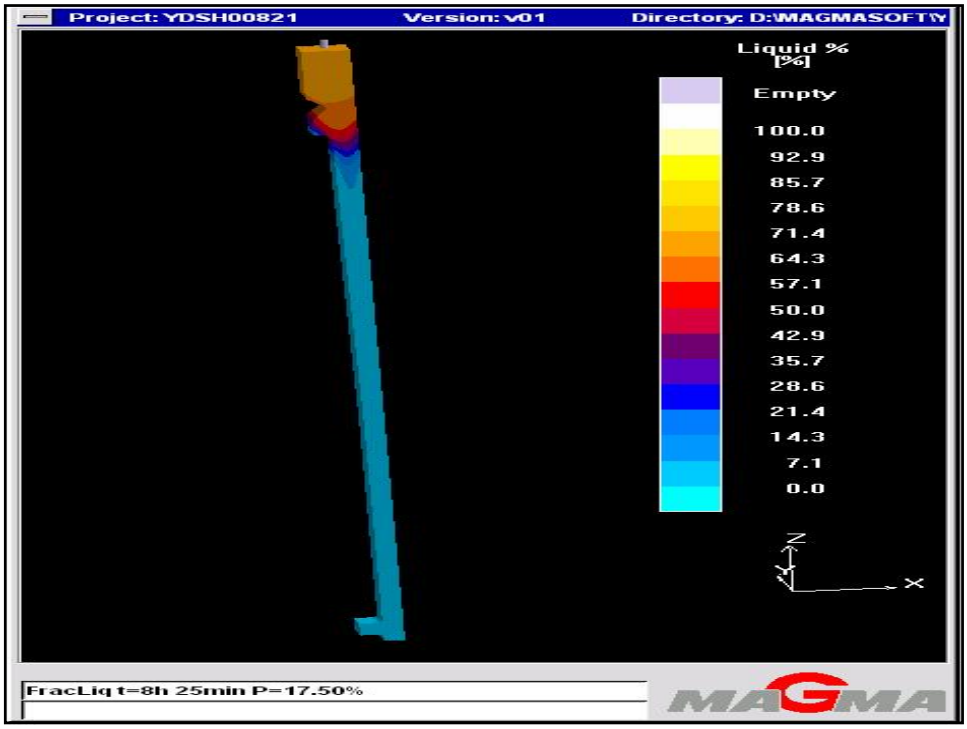
MAGMA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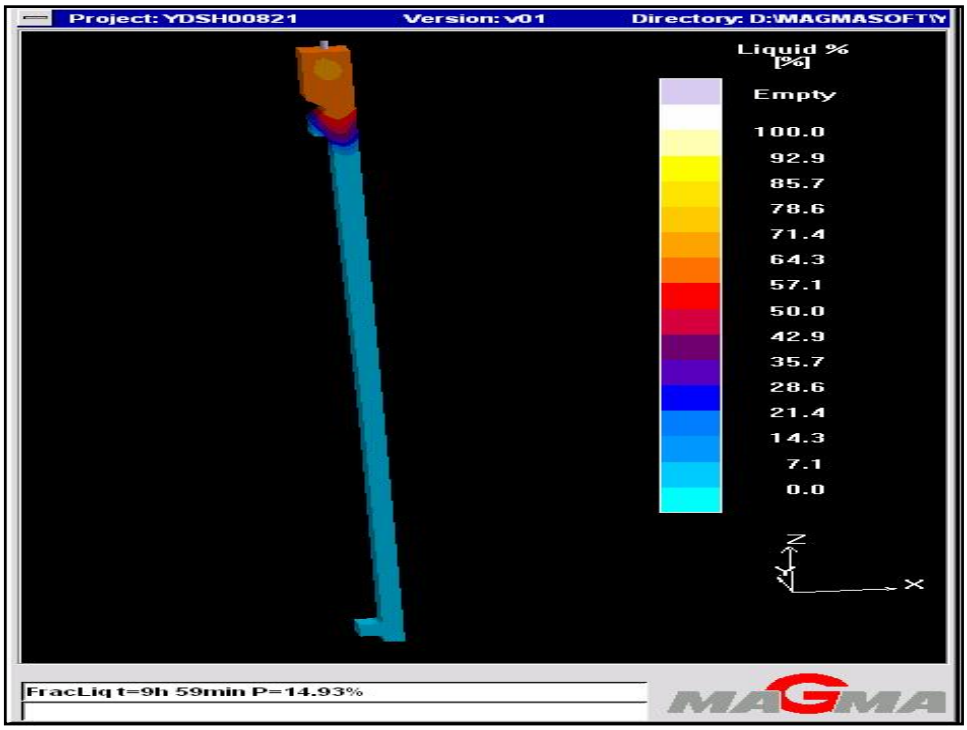
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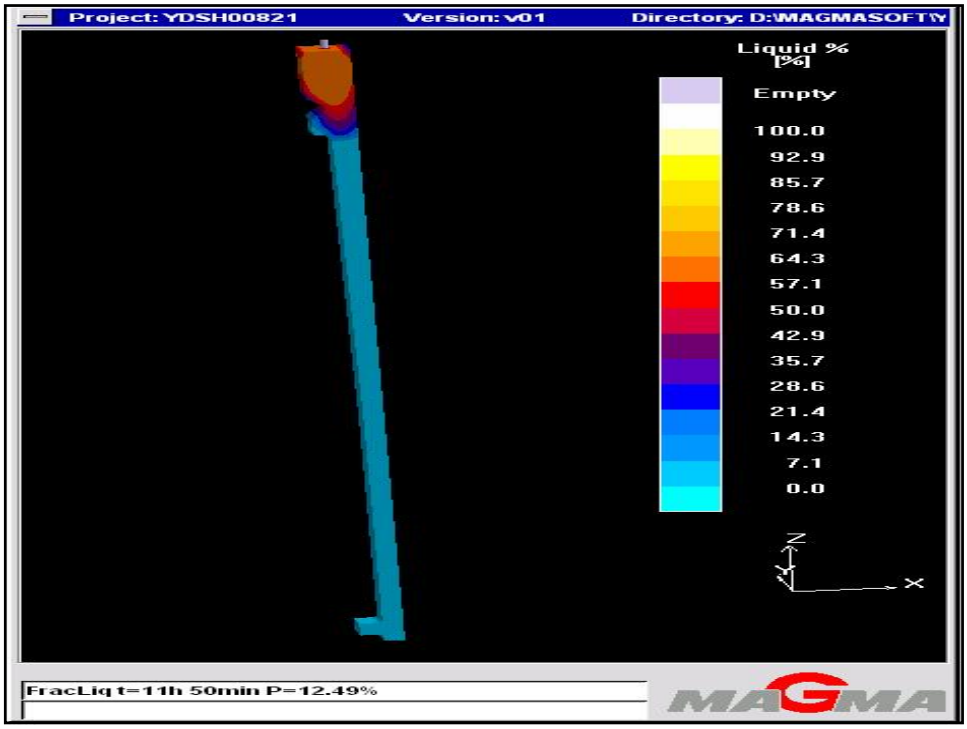
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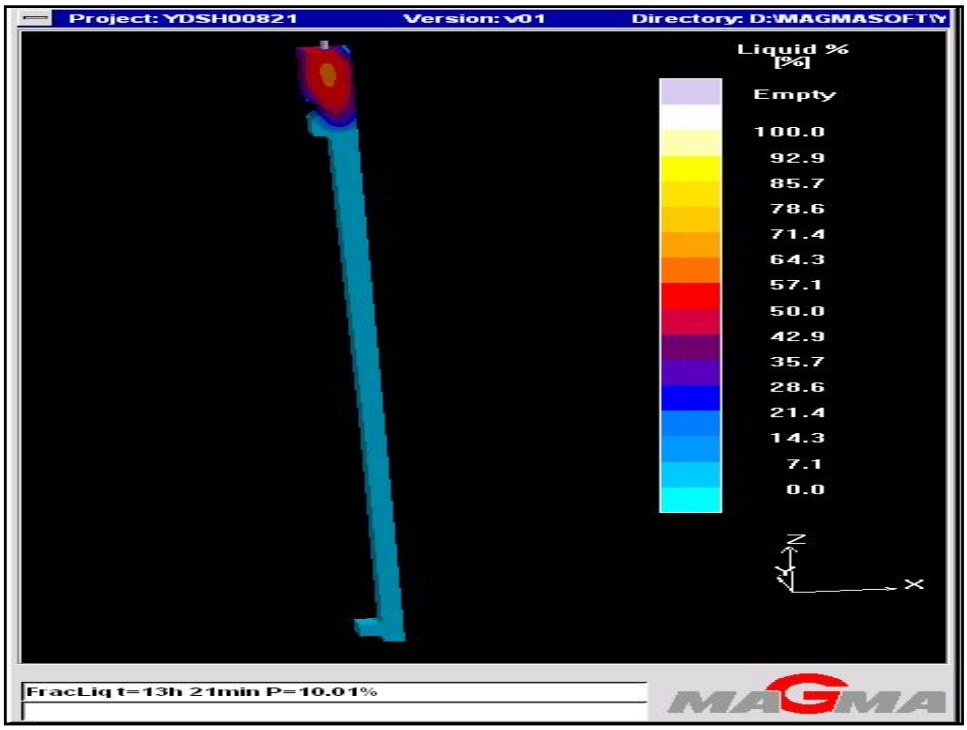
MAGMA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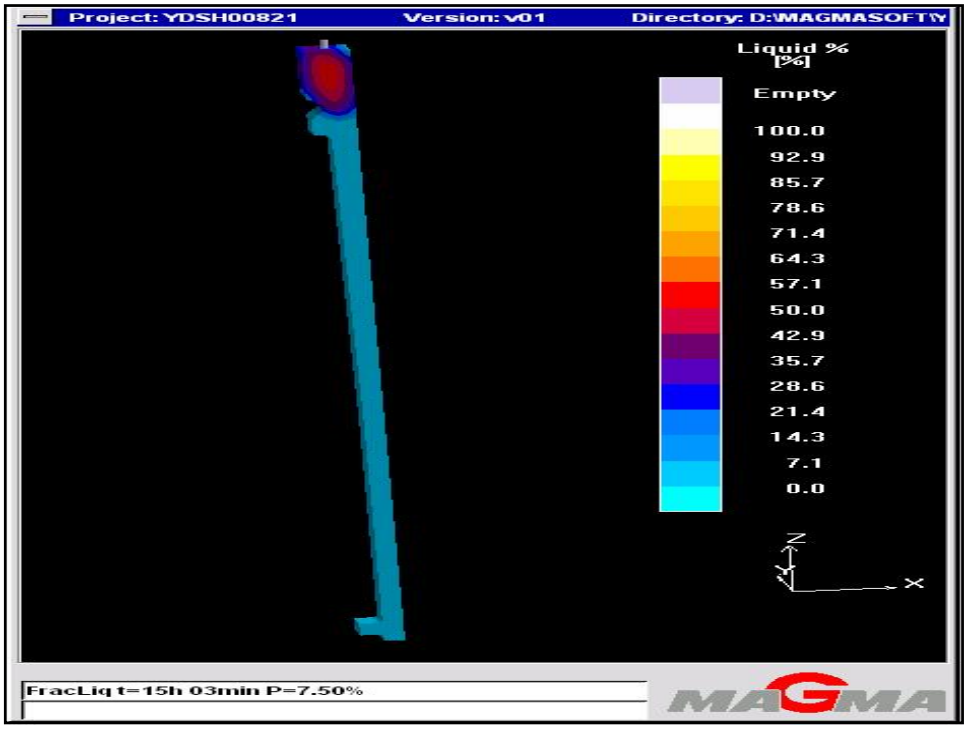
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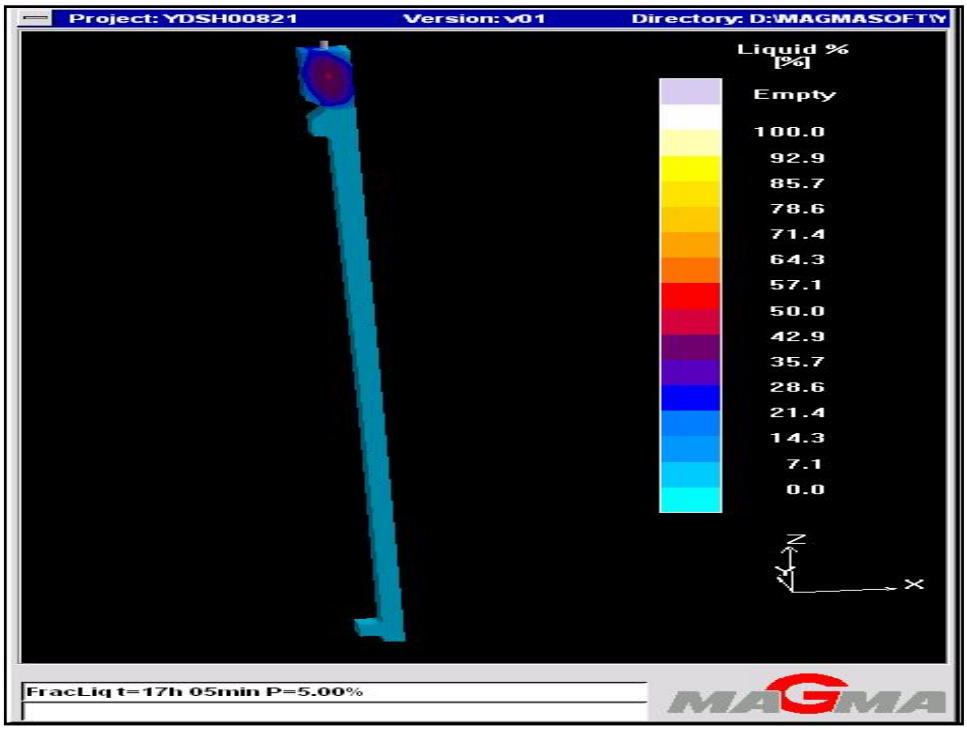
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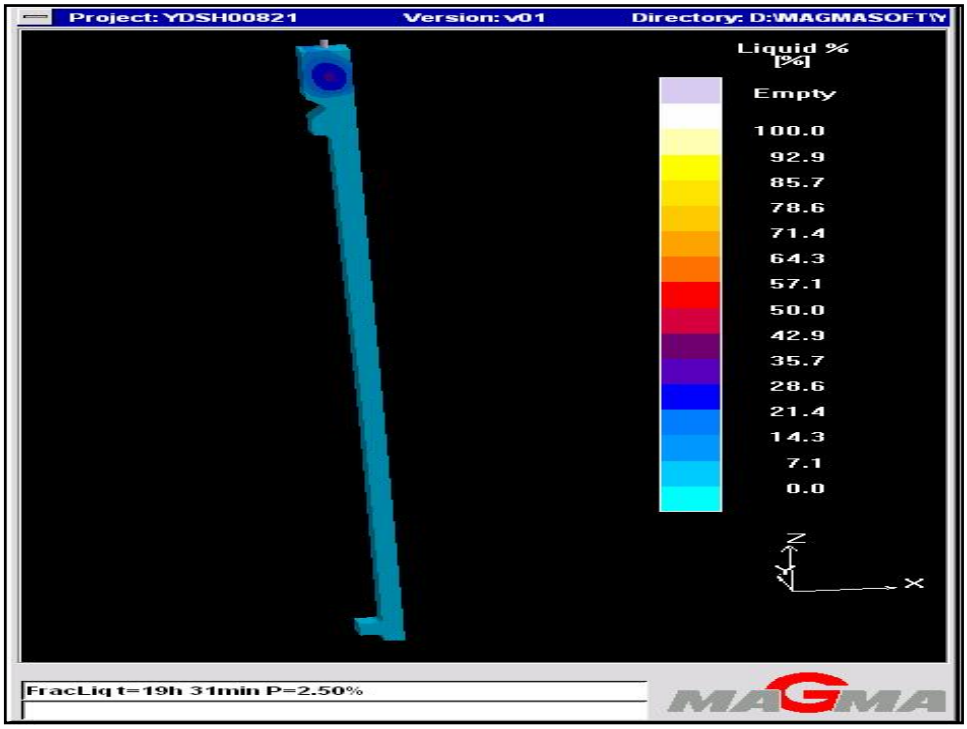
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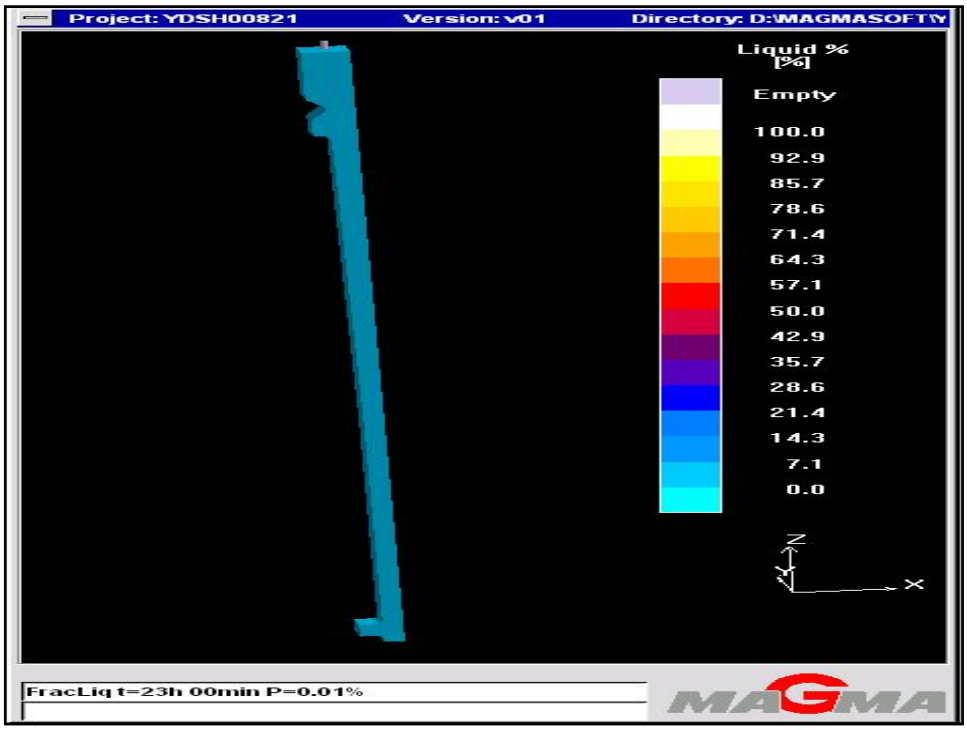
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Z
X
FracLiq t=23h 00min P=0.01%
MAGMA

The Yankee Shell Casting

On 7th November 2003 the first deep rib Sandusky Yankee shell was cast.

18ft diameter, 6.0 m long, 144 Tonnes.

The Casting remains in the Mould for 5 Weeks

The Resulting Casting Quality

Casting Quality:

- Tensile Strength - to specification
- Thermal Conductivity - above specification
- Radiographs - above specification
- UT shell - to specification

Papermaking:

- Started up November 2004
- Used with conventional 90kN/m roll press

Yankee Dryers for High Press Loads

Questions?

National Board
Yankee Dryer Appendix K
2004 Addenda

Inspection, Repairs, and Alterations
for Yankee Dryers

2004 Addenda K-3030

K-3030 PROCEDURES WHICH DO NOT REQUIRE STAMPING OR NAMEPLATE ATTACHMENT

All repair procedures, shall be acceptable to the Inspector, and when verified by the owner-user to not affect pressure-retaining capability of the Yankee dryer, do not require stamping or nameplate attachment. Examples of repairs are:

2004 Addenda K-3030

Grinding and machining

Metallizing (full face, spot, edge)

Epoxy filling of surface imperfection

Installation of spoiler bars

Maintain / repair / replace internal condensate removal system

A04 Driven plug repair when completed as described in K-3053.

2004 Addenda K-3053

K-3053 DRIVEN PLUG REPAIR A04

Shell surface imperfections may be repaired with smooth, driven plugs as described in ASME Section VIII, Div. 1, UCI-78, with the following additional requirements:

a. Maximum plug length (depth) shall be limited to 20% of shell effective thickness, and plug diameter shall not exceed the plug length (depth).

2004 Addenda K-3053

b. Total surface area of plugs shall not exceed 4 sq. in. in an 8 in. diameter circle (2580 sq. mm in a 200 mm diameter circle).

c. Average number of shell plugs shall not exceed one plug per 1 sq. ft. (1 plug per 0.1 sq. m) of the surface.

2004 Addenda K-3053

d. The land distance between edges of plugs shall be at least equal to the diameter of the larger plug.

e. The plug material shall conform in all respects to the material specification of the base material.

2004 Addenda K-3053

f. The installed plug shall have an interference fit. The average hold diameter is determined after the plug hole is drilled or reamed. The maximum plug diameter shall not exceed 1.012 times the average hole diameter. This provides an interference fit while minimizing the residual stresses.

2004 Addenda K-3053

g. All plug repair work shall be documented in the form of a plug repair map or other suitable method of recording and retained in the dryer's permanent file.

Appendix K - 2004 Addenda

Questions ?

Two Recent Yankee Incidents in Europe

TAPPI Yankee Safety Committee Meeting April 26, 2006
Magnus Högman - Metso Paper

September, 2005 - Failure at Warm-Up

- No personal injuries
- Low steam pressure and crawl speed -> “limited” explosion and consequential surrounding damages
- Yankee dryer completely failed with shell and heads broken into pieces.

Failure at Warm-Up cont.

Yankee Dryer Design Features

- Diameter 4500 mm (14 3/4') x 3700 mm (146") face, internally plain bore, made in Italy 1962
- Pearlitic cast iron
- Cap screw joints
- Gusset reinforced heads
- Overhung shell flange
- Bolted rope groove

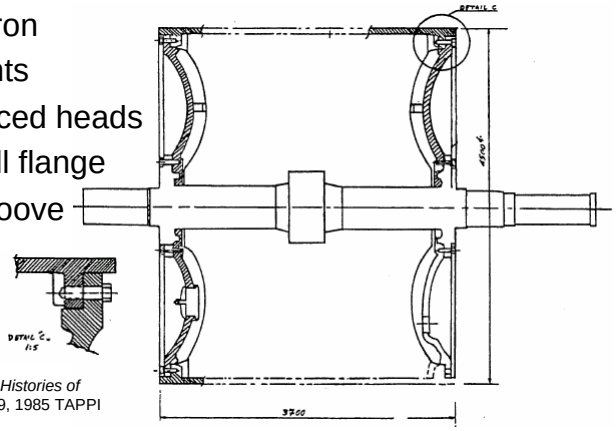
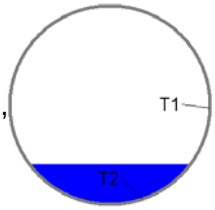


Figure from: F.J. Ferrari *"Case Histories of Yankee Dryer Failures"*, figure 9, 1985 TAPPI Engineering Conference

Possible Factors that May Have Contributed to the Yankee Failure

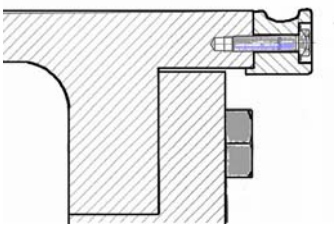
- Pre-heating without rotating the Yankee dryer (not confirmed) - with a stationary condensate puddle in the bottom of the dryer significant - and possible - critical temperature differences (T1 > > T2) may occur in the dryer structure, especially when it is finally rotated



- (Low cycle) Fatigue failure due to warm-up and cooling-down induced stresses - depending on design and warm-up and shut-down procedures “higher than normal” stresses are created in the Yankee dryer. Stresses that may be well below the yield/burst strength but exceed the fatigue strength, resulting in a fatigue failure after more than 40 years of warming-up and cooling-down.

Possible Factors…cont.

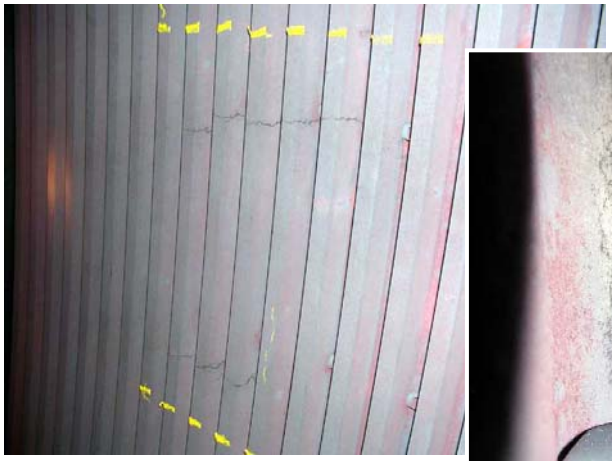
- (Infamous) Shell overhung design - reason for several Yankee dryer incidents. A high stressed section of the Yankee with significant increased risk for crevice corrosion. However in this particular case - a Yankee dryer used for glazing board paper - there were no corrosion jacking and due to the relative low machine speed (300 m/min / 985 fpm) there were less contribution to the nominal stress level by cooling. But…
- Bolted rope groove - threaded bolt holes in an already high stressed section may lead (and have led) to critical stress concentrations and the introduction of cracks



November 2005 - Shell Cracking due to Press Roll Cover Failure

- No personal injuries
- Roll cover failure during normal operation
- At first glance from outside the Yankee dryer looked OK - no steam leaking
- More thorough internal inspection revealed a massive cracking of the shell
- Yankee dryer immediately taken out of service

Massive Shell Cracking cont.



Why did the Shell Crack?

- Roll covers fails all the time without damage the Yankee dryer. In this particular case most of the cover went off with the exception for a section where cover residues not only stuck to the roll but folded double and repeatedly went through the nip until the machine could be stopped.
- The resultant nip load became very high damaging not only the Yankee but also the press roll.

- If a single stress shock would not have been enough the shell was exposed to an extreme form of low cycle fatigue until the machine was stopped.

References / Read More

- Fearnside, R.L., A "First Look" at Yankee Dryer Warmup Induced Stresses, 2003 Fall Technical Conference
- Service, T. H., Nalbandian, A., *Stress Analysis of an Overhung Flange and Head Sections in Yankee Dryers*, 1997 Engineering Conference Proceedings
- Tholke, B.W., *Case Histories of Yankee Dryer Failures*, 1991 Engineering Conference Proceedings
- Ferrari, F.J., *Case Histories of Three Yankee Cracking Incidents Associated with Shell Edge Extensions*, 1991 Engineering Conference Proceedings
- Ferrari, F.J., *Case Histories of Yankee Dryer Failures*, 1985 Engineering Conference

Voith Paper

VOITH

Ted Johnson

National Sales Manager

Tissue Cylinder Services

TAPPI Yankee Safety Subcommittee

April 26th 2006

Virtual Reference Grinding

A Revolutionary Approach to Yankee Profile Maintenance

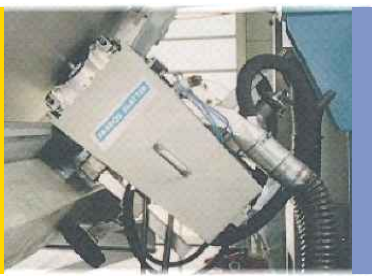
Grinding and Finishing

In-situ Services

- **Tangential Grinding for Yankee- and MG cylinders**
- **Doctor Mounted Grinding**
- **NOW: Virtual Reference Grinding.....**

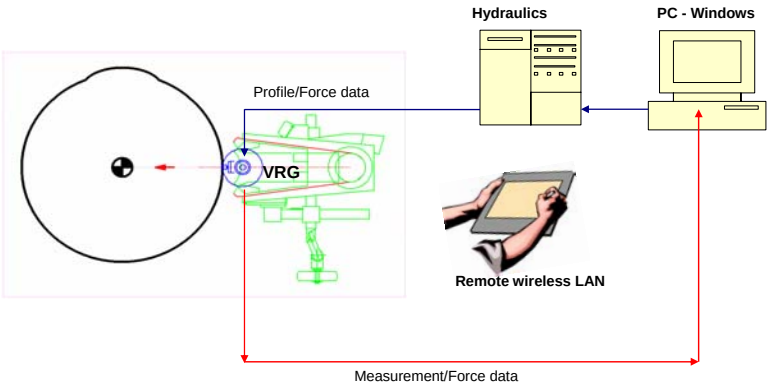
Previous Mobile Grinding Technology

Doctor Mounted Grinder (DMG)
Weight: 0.5 tons



'Tangential' Yankee Grinder
Weight: 5 tons

VRG – Virtual Reference Grinding

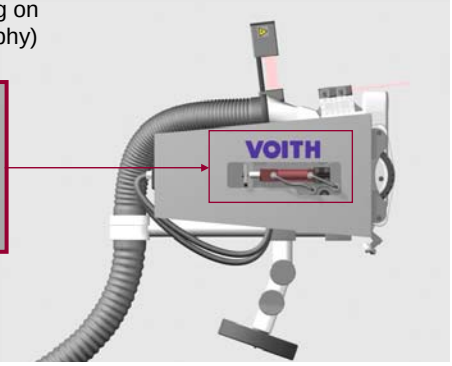


VRG is Fundamentally Different

Contact wheels loaded by fast-acting hydraulic actuators

Grinding force is variable depending on Yankee shape (geometry / topography)

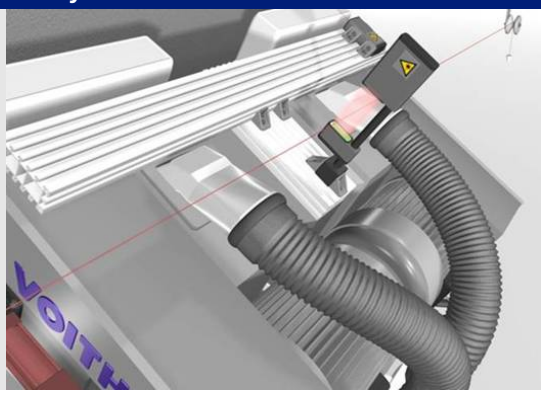
Fast and effective profile corrections in CD and MD



VRG is Fundamentally Different

Incorporated into the VRG system is a 'Virtual Reference'

Once the system is set-up and calibrated, a wire is used as a virtual reference from which the laser system measures the Yankee surface.

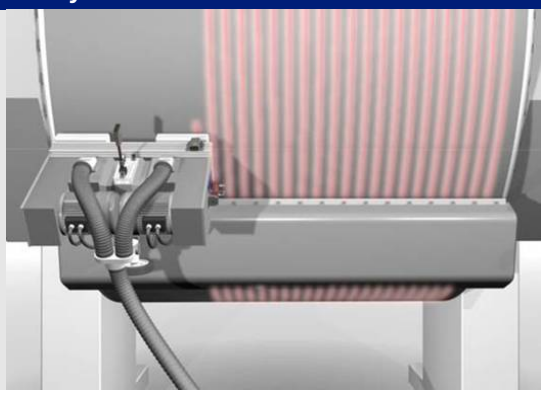


VRG is Fundamentally Different

Incorporated into the VRG system is a 'Virtual Reference'

Calculations are then processed to determine the existing Yankee shape.

The 'theoretical' (desired) Yankee crown shape is being super imposed.

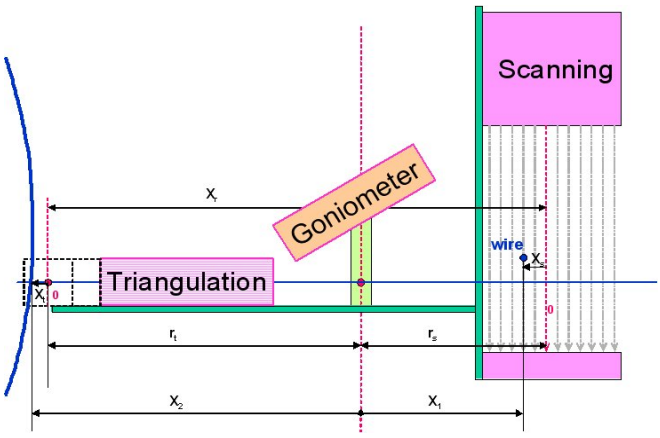


VRG is Fundamentally Different

Incorporated into the VRG system is a 'Virtual Reference'

The computer then compares the actual and theoretical crown shapes and calculates the amount and location of material to be removed. This is done in order to achieve the desired 'theoretical crown' while applying appropriate grinding forces.

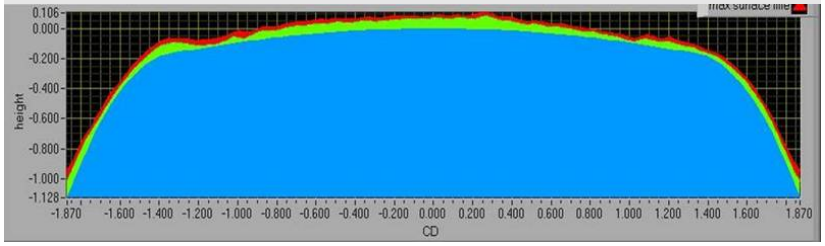
VRG - Laser Wire Guidance System



Representation of Data Acquisitions

Max / Min – Profiles

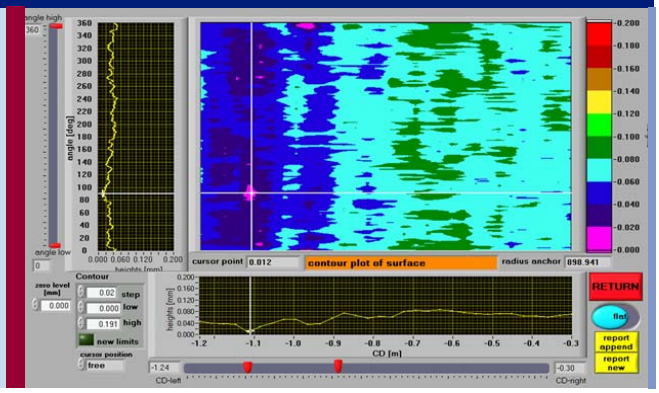
- Total Indicated Runout (TIR)
- Theoretical crown
- Difference (theoretical vs. actual)



Calculation of Surface Description

Axial and Radial Profiles

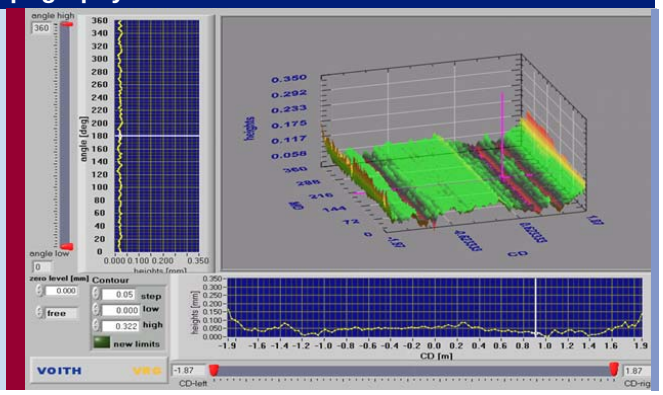
2-D Topographical Mapping



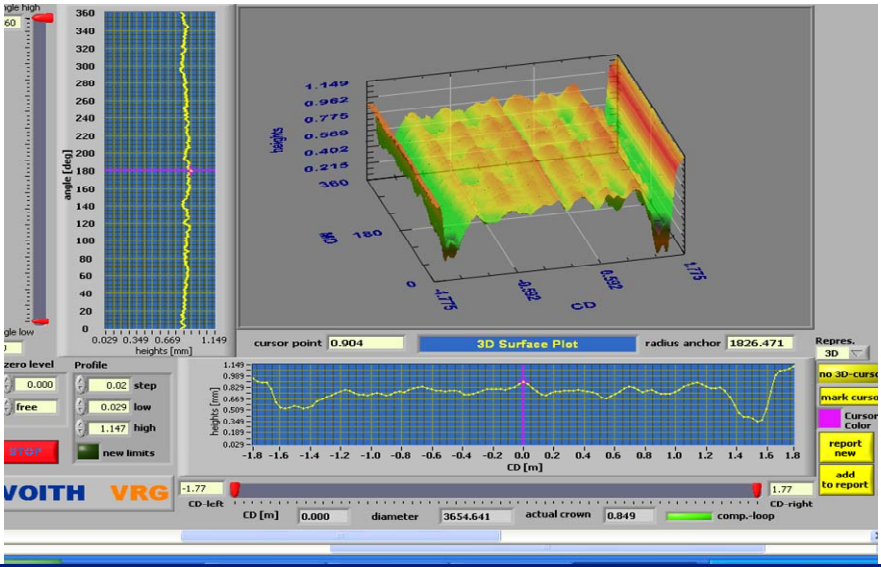
Calculation of Surface Description

3D plots of topography

Compute any axial or radial point



Mapping - 3D View

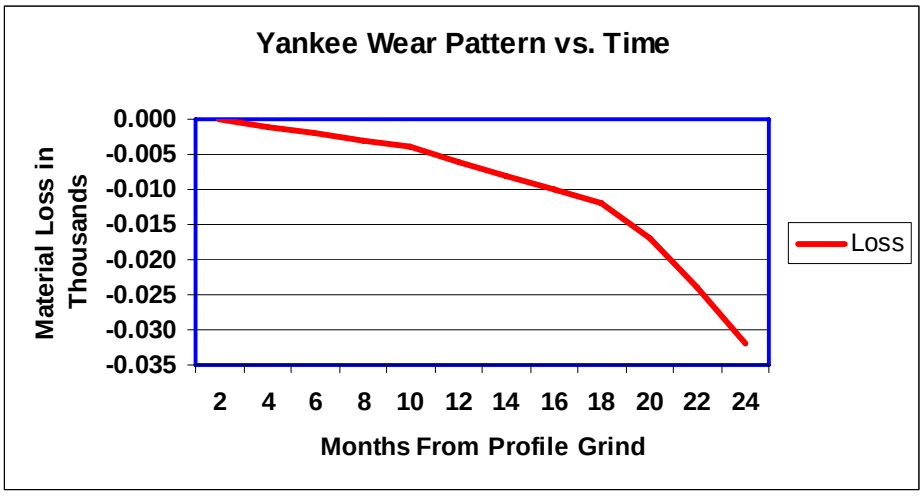


A True Revolution.....Voith's VRG Technology

The VRG can be also be mounted on pressure roll side of machine by using our custom stands or mounting brackets

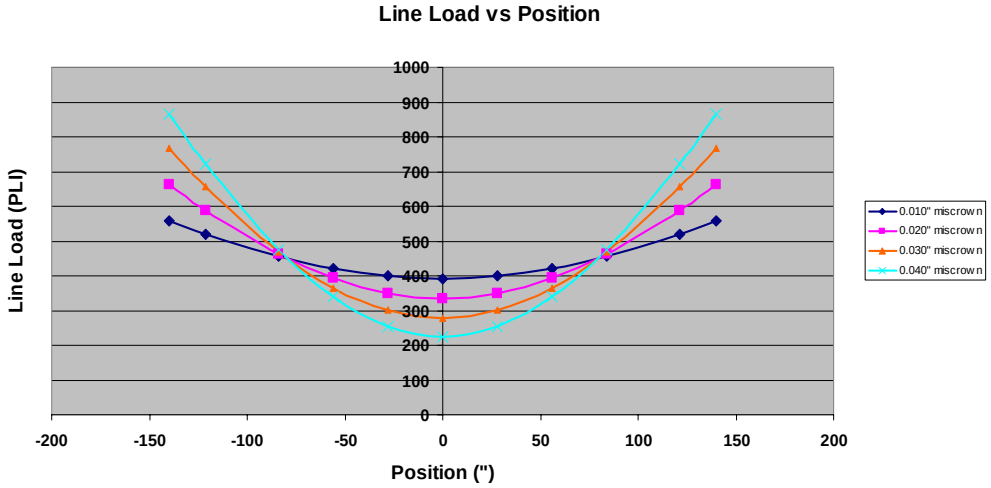
VRG YANKEE PROFILE MAINTENANCE PROGRAM

- **GOALS...**
- ***Change paradigm of Yankee Cylinder Profile Grinding Using VRG***
- Increase profile grinding frequency (reduce time between grinds)
- Reduce base metal removed at each grind.
- Reduce on-machine grind time by **50%** or more



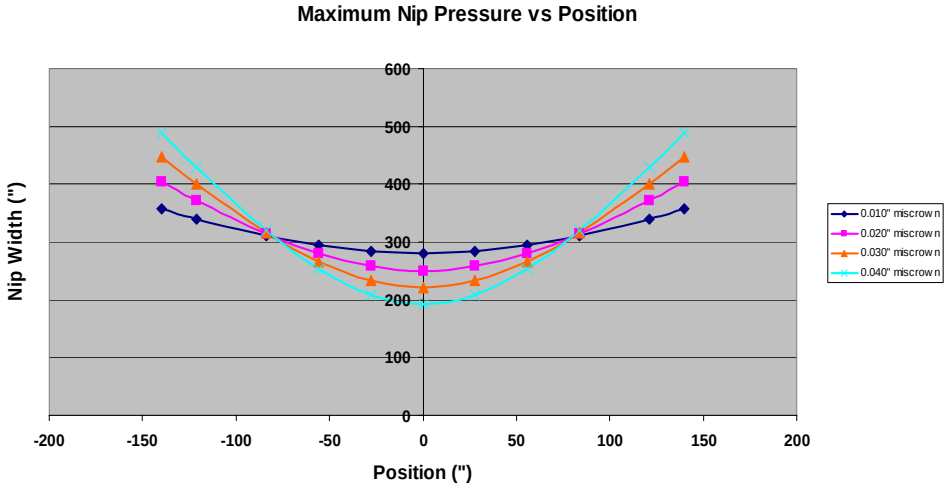
Effect of Miscrown on Covers

40” roll; 18’ Yankee; 450 PLI; 40 P&J, 7/8” cover



Effect of Miscrown on Covers

40” roll; 18’ Yankee; 450 PLI; 40 P&J, 7/8” cover



Advantages of VRG Yankee profile Maintenance Program

- Reduced Downtime associated with Profile grinding
- Increase in asset life (30% reduction in base metal removal)
- Improved productivity and quality by reducing wear curve effects
- Reduce pressure roll wear

VRG Yankee Profile Maintenance Program

Direct Dollar Savings

Based On 6 Yr Cycle

# of Grinds	Downtime per	Total DT	Cost per Grind	Total Grind $	Removal
Traditional TG Grinding					
24 months – 3 Grinds	72	216	$50,000	$150,000	.090”
New VRG Program					
18 months – 4 Grinds	44	176	$57,500	$230,000	.060”
Hrs Saved	40		Add. Grind $’s	$80,000	
Savings At $7,500 per Machine Hour				$300,000	

Net Direct Savings
$220,000.00

Thank You For Your Attention