Glass conditioning with the SORG 340S+ forehearth
Introduction

- Introduction
- Glass conditioning basics
- The cooling system
- The heating system
- The control system
- Add-on systems
- Operational results
- Conclusions
INTRODUCTION
Glass conditioning – a very important process of making good products

Majority of rejects originate from processes after melting.
Glass conditioning – a very important process of making good products

Provision of the required amount of glass with the correct temperature and a suitable level of thermal homogeneity and stability to the forming process at the machine
Glass conditioning – a very important process of making good products

Typical operating conditions for a glass conditioning system

Correct pull / glass level
Correct temperatures (+/- 1K)
Homogeneity (96-98%)
Stability
Glass conditioning – a very important process of making good products

Typical operating conditions for a glass conditioning system:

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Furnace outputs:
- 140 t/d at 1140 °C
- 55 t/d at 1160 °C
- 130 t/d at 1170 °C
- 75 t/d at 1150 °C

Graphical representation: "HOW MANY OPERATORS?"
Glass conditioning – a very important process for making good containers

Our Approach:

- Forehearth design only as complex as necessary
- Ease of operation
- Reliability through design, material and equipment
- Best control strategies
- Every development has to be seen through the eyes of the user
What does the 340S+ stands for?

A very short history:

- SORG designs forehearth for a very long time, over 40 years with a dedicated department for glass conditioning.
- SORG took over the glass conditioning business from Emhart in 2006, continuing own forehearts (STF) and Emhart’s (240, 340, 640).
- Introduced the 340S in 2009, which combined the “best of both worlds” with great success.
The SORG® 340S+ Forehearth
Glass conditioning – Basics
Heating and Cooling

The three methods of heat transfer

Conduction
- the passage of heat through a body

Convection
- the passage of heat by movement of a carrier (gas or liquid)

Radiation
- the passage of heat between bodies (transmitter and receiver) by electro-magnetic waves
Glass conditioning – Basics

Heating and Cooling

Heat transfer

Heat transfer into and out of the glass, BUT ALSO within the glass bath is almost completely by radiation
Glass conditioning – Basics

Heating and Cooling

Heat transfer

glass temperature begins to drop

glass bath surface temperature $T_1$ begins to drop

we have now created temperature differences in the glass bath $T_2 > T_1$

heat transfer inside the glass bath begins – $Q_2$
Glass conditioning – Basics
Heating and Cooling

Heat transfer

Heat transfer within the glass bath is a significant LIMITING factor

We need TIME to allow for heat transfer in the glass bath
Glass conditioning – Basics

Glass Flow

Flow Pattern

Glass near to sidewalls and bottom:

- Flows more slowly because of friction
- Has a longer residence time
- Loses temperature because of heat losses
- Increases in viscosity because of lower temperatures
- Flows more slowly because of friction and higher viscosity
The 340S®/340S+ Cooling System
The SORG® 340S+ Forehearth
Cooling System

A unique combination of indirect and direct air cooling
The SORG® 340S+ Forehearth
Cooling System

A unique combination of indirect and direct air cooling
The SORG® 340S+ Forehearth
Cooling System

NEW: Cover plate single piece, no longer separated
The SORG® 340S+ Forehearth
Cooling System

NEW: Central Cooling Air Supply

ONE fan with standby
With VSD
The SORG® 340S+ Forehearth Cooling System

NEW: Central Cooling Air Supply
The SORG 340S+ Forehearth Cooling System

NEW: Central Cooling Air Supply

only with ONE fan
Instead of multi-fans
The SORG 340S+ Forehearth Cooling System
The SORG® 340S+ Forehearth Heating System
The SORG® 340S+ Forehearth
Heating System

- Gas flow pressure tappings
- Gas proportioning valve
- Gas orifice plate
- Non-return valve
- Air flow pressure tappings
- Air control motor and valve
- Air orifice plate
- Air/Gas mixer
- To burner manifolds
- No air bypass

No air bypass
The SORG® 340S+ Forehearth Heating System

- The SORG VMC high pressure gas heating system is used for all heating zones
- Can have combined left/right heating and control or separated left/right heating. Separated left/right heating is mostly used for
  - channel widths of 42" or more
  - forehearths with corners / bends
  - special cases
The SORG® 340S+ Forehearth
Heating System

Safety valve in EACH zone:
Upgraded availability
The SORG 340S+ Forehearth Heating System

SORG combi burner nozzles

- Increased heat resistance
- Less susceptible to dirtying and blockage
- Supplied more than 75 000
The SORG® 340S+ Forehearth
Control System
The SORG® 340S+ Forehearth Control System

Forehearth operation is a complex, Multi-Input, Multi-Output process

- many control loops
- very flexible and can work well even in difficult situations
The SORG® 340S+ Forehearth

Control System Future: ESIII™

Simplified operation: only 1 setpoint for 9-Grid

Full automatic control for all forehearth zones

Automatic forehearth preconditioning for job change
The SORG 340S+ Forehearth
Add-On Systems

Available Options

- Forehearth CONTI-DRAIN®
- Equalising section electric boosting system
- The OMT forehearth oxygen monitoring and control system
- Stirrer units
- Forehearth colouring
- SORG Service Contracts
The SORG® 340S+ Forehearth
Add-On Systems: CONTI-DRAIN®

Forehearth CONTI-DRAIN®

Basic Requirements

- Very slow and controlled drain
- High drain flexibility
- Simple operation

NEW: CDNE version

- No counter electrode in glass contact
- No risk of glass contamination from the electrode in sensitive glasses
The SORG® 340S+ Forehearth
Add-On Systems: Side wall Boosting

Forehearth side wall boosting system

To achieve highest levels of thermal homogenity
Especially for colored glasses
Direct, fast and flexible tool
NEW:
Realization using top-electrodes
Top electrodes can be removed during flint runs
The SORG® 340S+ Forehearth
Add-On Systems: OMT Oxygen metering trim system

- Oxygen analysis directly on forehearth
- Automatic adjustment of air/gas ratio
- Bleed air added to adjust air/gas ratio
- Transmitter

Evaluation unit

SORG VMC air/gas premix system
The SORG® 340S+ Forehearth
Add-On Systems: OMT Oxygen metering trim system

Keep the correct ratio

When using natural gas with 8600 kcal/Nm³ the mixture should have 18,92% O2.
18,8% means you use 10% too much gas.
18,7% means you use 10% too much gas.
The SORG® 340S+ Forehearth

Service

- Installation and commissioning
- Audit existing installations (operation and rebuild recommendations)
- Training (classroom and on-site)
- Service contract
SORG® 340S+ forehearth operating results

- 135 t/24 h
- UVAG green glass
- THI 97,40 %
Without boosting!
SORG 340S® forehearth operating results

- 133 t/24 h
- flint glass
- THI 99.10 %

Triple gob
SORG 340S® forehearth operating results

- 115 t/24 h
- green glass
- THI 97,9 %
SORG 340S® forehearth operating results

- 103 t/24 h
- amber glass
- THI 97,4 %

without boosting
SORG 340S® forehearth operating results

- 157 t/24 h
- amber glass
- THI 97,0 %

Quad gob

with boosting 8-4
Advantages of STW-340S+ system:

- Central cooling air supply – reducing time and effort and maintenance
- Efficient, redundant cooling air supply (VSD)
- Self cleaning dampers, simplified design for a maintenance-free chimney
- Superstructure steel simplified design for faster installation
- VMC system with constant air/gas ratio (EN746-2)
- Steel/ceramic nozzles (most competitors use steel type)
Advantages of STW-340S+ system:

- Proprietary add-on systems (CONTI-DRAIN®, OMT, Stirrer, side wall boosting, Colour Fh)
- Continuously optimised design
- Reliable and proven refractory
- Excellent multi gob experience (many quadruple gob, triple gob installations)