DETAILED TRAINING PROGRAM

BATCH, FURNACE & GLASS CONDITIONING TRAINING

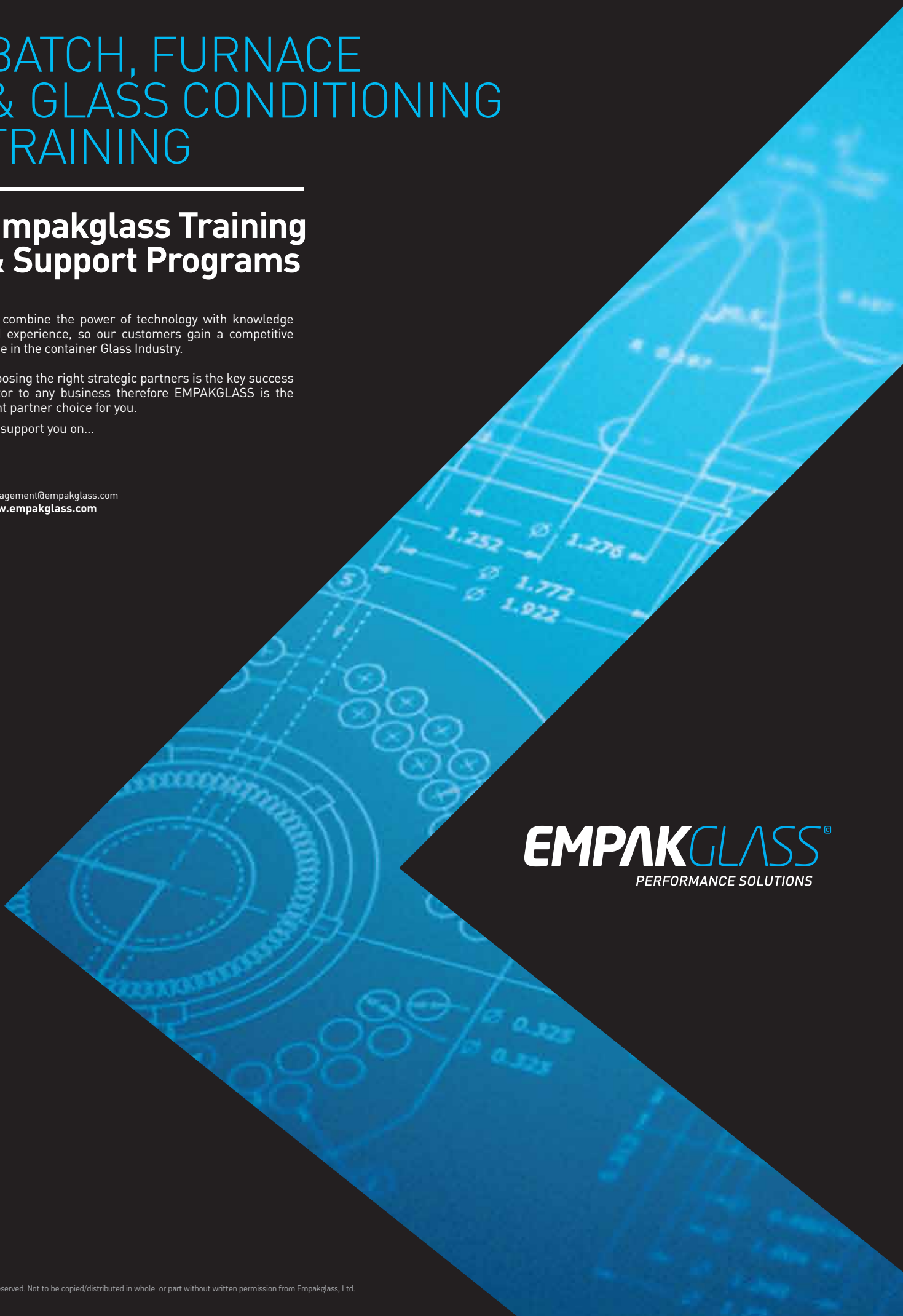
Empakglass Training & Support Programs

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you.

We support you on...

management@empakglass.com
www.empakglass.com



EMPAKGLASS©
PERFORMANCE SOLUTIONS

BATCH, FURNACE & GLASS CONDITIONING TRAINING

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you. We support you on...

Empakglass Training & Support Programs

DETAILED TRAINING PROGRAM

BATCH, FURNACE & GLASS CONDITIONING TRAINING

INTRO

The Batch and Furnace Division of Empakglass prepared the Batch, Furnace and Glass Conditioning training which provides a complete overview of the technical aspects of the different process stages from raw materials reception to glass conditioning.

The training encompasses topics as: process operation, equipment's maintenance, physical and chemical process, standard operational practices, economical optimization and glass quality defects.

The detail level of the training is adjustable for both more experienced and industry newcomers.

The training is structured in a 15 days schedule with both theoretical and practical components side-by-side.

We have the flexibility to adjust to customer needs the schedule of the 15 days training duration allowing to have the training in one complete or in more partial sessions.

As part of this training or as a separated package - the customer chooses - the Batch and Furnaces Division of Empakglass prepared 3 different manual packages.

› Blisters recon manual for B&F operation: for the identification of blister sources and troubleshooting its origin;

› Stone recon manual for B&F operation: for the identification of stones sources and troubleshooting its origin:

› Heat-up procedures for furnaces start-ups: for setting up the correct procedures in the process of a furnace start-up.

Performance Solutions
New markets / New Opportunities / Independency

We speak your language

Please contact us with your questions, even if you do not find the topic on this brochure, we will come back to you with an answer and proposal for solutions.

Inquires/orders can be made directly to: **management@empakglass.com**

Standard quotes have been defined. Depending on the customer's needs, modified quotes will be issued.

BATCH, FURNACE & GLASS CONDITIONING TRAINING

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

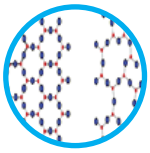
Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you. We support you on...

Empakglass Training & Support Programs

DETAILED TRAINING PROGRAM

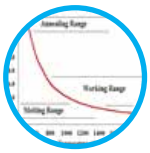
BATCH, FURNACE & GLASS CONDITIONING TRAINING

CONTENTS



1. GLASS TECHNOLOGY

Definition of a glass. Requirements of a commercial glass composition. Glass composition. Properties. Redox. Glass batch calculation. Glass defects.



2. GLASS PROPERTIES

Viscosity. Thermal expansion coefficient. Density. Chemical durability. Redox.

3. RAW MATERIALS

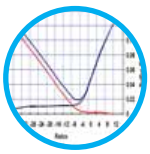
Glass making raw materials. Properties of glass making raw materials. raw material chemical specifications. Raw material sizing specifications. Raw material example spreadsheet. Raw material refractory particle specifications. RM & batch scale weighting. Raw materials granulometry. Raw materials issues. Alternative raw materials issues. Monitoring raw material quality.

4. BATCH WETTING

Batch wetting effect - ablation. Batch wetting effect - the chemistry

5. CULLET

In plant. Outside plant: unprocessed, furnace ready. Cullet processing.
Cullet contamination. Culler inspection table. Cullet sampling. Sampling procedure. Evaluating results. Rejection slip. Log book. Color content evaluation. Cullet storage. Cullet bunkers. End loaders. Cullet processing & quality issues.



6. REDOX

Effects of redox on glassmaking. Redox factors. Factors for calculating redox.
Sulfur retention vs. redox.

7. SEGREGATION IN SILOS

Segregation issues in silos. Silos filling. Silos discharge. Hopper design and position issues. The mixer. The ribbon mixer. The rotating pan. the mixing time vs. homogeneity.

BATCH, FURNACE & GLASS CONDITIONING TRAINING

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you. We support you on...

Empakglass Training & Support Programs

CONTENTS

8. FURNACE DESIGN STANDARDS

Modern regenerative end fired furnace. Melting end design with port and throat. Port neck and burner walls. Melting end design superstructure. Skew back situation. Superstructure side wall. Superstructure tuck stones. Installation examples. Crown. Crown insulation examples. Melting end - substructure design. barrier materials. barrier objective. transition of tank block to the bottom structure. Solution of electrode blocks imbedded in the bottom structure. SORG design on doghouse arches. OI design on doghouse arches. barrier wall and bubbling row design. Refining area. Other approaches to bottom melter design: the OI design. Melting end throat designs. Horizontal throat design. Sloped offset throat design. the OI throat design: a case study. Furnace objectives: the OI design. Working end substructure design. Working end corner design.

9. REGENERATOR DESIGN STANDARDS

Different design approaches. types of refractories. Types of checkers. Case studies.

10. GAS AND OIL BURNERS

Existing burner designs and its operational capacities.

11. ELECTRICAL BOOSTING SYSTEMS

General. Electrode location. Control system. Operation data. Maintenance. Safety.

12. FURNACE OPERATION: HOW TO COMPARE DIFFERENT FURNACES

Comparison of furnaces. Comparison method from Beerkens.

13. FURNACE OPERATION

Furnace operation choices/priorities. Glass formation. The chemistry. The physics. refining process: introduction; sulphur reactions in batch blanket; sulphur species in glass melt; sulphate fining & modelling; temperature, oxidation.

BATCH, FURNACE & GLASS CONDITIONING TRAINING

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you. We support you on...

Empakglass Training & Support Programs

CONTENTS

14. THE COMBUSTION PROCESS IN THE FURNACE

Combustion issues. Energy sources & consideration. Combustion chemistry. Combustion systems. Burner principle. Requirements. Fuel and air (oxygen) mixing. Primary air. Low NOx flames. Regenerative furnaces. Oxy-fuel firing. Flame types. Flame shaping - flame adjustment. Heat transfer and NOx. Flame shapes, examples. Flame length. Other aspects of firing. Heat transfer. Heat flux - emissivity. Flame emission coefficient. Flame emissivity. Calculation of total radiative emission reduction. How and where to measure the combustion exhausts. Plotting exhaust gases data and correlating with the physics of the furnace: origin and consequences of the problem.

15. BUBBLERS vs BARRIER BOOSTING

Design elements - bubbling. Design elements - barrier boosting.

16. GLASS CONDITIONING

The layout. The philosophy of glass conditioning. The cooling systems. Comparison of cooling capacities. Cooling and thermal homogenization. Arrangement of cooling systems on a typical installation. The PP technology - basic principle. Radiation cooling system - mechanical parts. Cooling systems - the stepping control system: advantages. The gas heating system. Layout. Premix production details. Ceramic burner nozzles. Control systems. heating zone. Cooling section. Thermocouples. the refractory superstructure. Channel blocks. Superstructure. The mounting. The homogeneity calculation. Equalizing section electrical boosting system. Operating results. Installation of electrodes. Special features. other approaches to working end design: the Owens-Illinois design - a case study.

17. GLASS QUALITY TROUBLESHOOTING

The basic approach.

18. CORD, SEEDS, BLISTERS, STONES & SURFACE CORD

Cord. Causes of cord. Stones. Stone identification. Seeds and blisters. Carbon-sulfate fining system. Common causes of seeds. Blisters. Blisters characteristics. Common causes of blisters. Surface cord. Common surface cord origins. Optical distortion. Origins of optical distortion.

BATCH, FURNACE & GLASS CONDITIONING TRAINING

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you. We support you on...

Empakglass Training & Support Programs

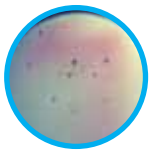
CONTENTS

19. STONE COUNTING METHODS; PROCEDURES AND EQUIPMENT

Determination of stone levels. Stone counting procedures. Routine stone counts. Reacting to elevated stone counts. Supplemental stone count. Submitting stones samples to laboratories.

20. DETERMINATION OF SEED LEVELS

Purpose. Safety. Application. Procedure. Reporting seed levels. Reacting to elevated seed levels. Submitting samples to labs.



21. DETERMINATION OF BLISTER LEVELS

Purpose. Safety. Application. Procedure. Reporting blister levels. Reacting to elevated seed levels. Submitting samples to labs.

22. MINI GLASS DEFECTS CLASS

Survey of glass defects and definitions. Glass defects from recycled glass cullet. Stone, cord and knots from refractories. defects from devitrification. Bubbles. Various other defects. Analysis techniques of glass defects. Analysis techniques of bubbles.

23. MINI CORDS CLASS

Cord. Cord retardation measurement. Quartz wedge for measuring retardation. Stress calculation. Cord analysis - sample collection. Cat scratches.

24. RHM HEAVY LIQUID SEPARATION PROCEDURE

RHM particle evaluation procedure. Purpose. RHM heavy liquid separation procedure. Purpose. Why do RHM evaluations. Required equipment. Sampling procedures. Heavy liquid separation procedure. Required equipment. Evaluation procedure. Preparing platinum foil boats.

BATCH, FURNACE & GLASS CONDITIONING TRAINING

We combine the power of technology with knowledge and experience, so our customers gain a competitive edge in the container Glass Industry.

Choosing the right strategic partners is the key success factor to any business therefore EMPAKGLASS is the right partner choice for you. We support you on...

Empakglass Training & Support Programs

DETAILED TRAINING PROGRAM

BATCH, FURNACE & GLASS CONDITIONING TRAINING

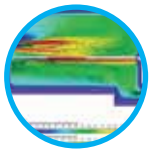
CONTENTS

25. COLOUR CONTROL

The measurement and control of glass colour. C.I.E. Measurement System. Dominant wavelength. Purity. Brighteness. Chromaticity diagram. CIE L *a *b system. Flint glass colour control. Flint colour specifications. Amber colour control. Amber glass redness ratio. Amber colour specifications. High cullet use in amber. Oxidized green colours. Ultraviolet absorbing or reduced green colours. Reduce green colour control. Culler usage in reduced greens.

26. COLOUR CHANGES

Colour change history. Sulphur solubility. General recommendations, Conference call. Furnace bottom temperature. Throat well bubblers. Bubblers. Furnace pull. Melter bubblers. Redox changes. redox & dark to light changes. Melter foaming. Preliminary information. Calculations. Property changes: thermal expansion coefficient, viscosity, cooling time, density. Flint to amber colour change. Amber to flint colour change. Flint to emerald green colour change. Emerald green to flint colour change. Amber to emerald green colour change. Emerald green to amber colour change. Flint to dead leaf green colour change. Dead leaf green to flint colour change. UV Champagne green to dead leaf green. Batch or cullet change notes. Property targets. Reduced green & amber cullet adjustments. Oxidized green & flint cullet adjustments.



27. FURNACE TYPES

Furnace concepts. Case studies.

28. CONTIDRAIN

System overview.

29. COLORING FOREHEARTH

Forehearth colouring technology.

Performance Solutions
New markets / New Opportunities / Independency

We speak your language

Please contact us with your questions, even if you do not find the topic on this brochure, we will come back to you with an answer and proposal for solutions.

Inquires/orders can be made directly to:
management@empakglass.com

Standard quotes have been defined. Depending on the customer's needs, modified quotes will be issued.