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Technical Paper

THE MOST ADVANCED TECHNOLOGY FOR THE GLASS MARKET: SERVO FEEDER THAT CAN OBTAIN DIFFERENT GOB WEIGHTS WITHIN THE SAME MACHINE CYCLE.

Abstract:

Globalization of world markets is a source of new and evermore complex challenges between diverse businesses which perform in open competition.

The hollow glass market also requires new and high level state of the art technology, suitable to guarantee a product which is constantly competitive and of quality, which satisfies the customers established time method and quantity requirements..

BDF, which has always been careful towards customer requirements and for decades has been in the forefront of technology for hollow glass production machinery, introduces it's own new servo feeder equipped with a new and sophisticated movement control which is able to produce gobs with variable weights within the same machine cycle,

This technology is the result of synergies between BDF and a leading multinational glass industry group: technology know-how from one side and formation process know-how from the other, have worked in mutual accord to guarantee maximum performance for servo mechanisms.

Flexibility at every level: this is what the new equipment, which has been in production for some time with very positive results, can guarantee.

"Just in time" production, free scheduling of production, stock reduction, reduction of mould maintenance, production mix optimization, article weight optimization: are all objectives that are of great importance to producers and that can be reached with BDFs servo mechanism, which is already obtaining these results in many production plants.

The high performances obtained are the result of the advanced technological achievements that BDF is able to apply to its products, and the outcome of in-depth studies and of considerable investments in research and testing.

Speaker:
Dr. Eng. Vitaliano GREGORI
Technical-Commercial Manager

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BDF - Boscato & Dalla Fontana SpA - Vicenza - Italy

- The most advanced technology for the glass market: Servo Feeder for variable gob weights.
- Speaker: Eng. Vitaliano GREGORI - Technical-Commercial Manager

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The BDF HOLDING structure

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The BDF HOLDING Companies for the Glass Market

- BDF Boscato & Dalla Fontana, Glasservice, BDF Servis - Croatia: IS Machines, Feeders, Equipments, Spare parts, Engineering for the hollow glass market, Design, set-up and start-up of turn-key plants, Installations and services.
- TDE MACNO: System automation and engineering for IS machines, Drives and inverters for motors, Factory automation, Electronic researches.
- Glass Technologies, MCR: Batch Plants, Furnaces, Forehearths, Working Ends, Engineering and Hot Services, Demolition and assembly, Electronic controls for batch plants and furnaces.

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Today requirements of the hollow glass market

- a product which is constantly competitive:
    - high quality,
    - low price;
- to satisfy the customers requirements:
    - to offer the required product (shape and weight);
    - in a short time from the order,
    - in the ordered quantity.

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BDF cooperates to satisfy the glass market requirements

- BDF has a 50 years experience in IS machine and related equipment and tightly cooperates with the most famous glass makers;

- TDE MACNO, as Certified Research Laboratory for the Italian University, performs the latest electronic solutions for the factory automation;
- GLASS TECHNOLOGIES as leader company in the furnaces market:
- as RESULT: the most advanced technology for the glass factory

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A typical production range

Short - Medium - Long Series

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A typical production range

Short - Medium - Long Series

- typically in out-of-standard shapes;
- can be produced as "mix of articles" in the same IS machine in the same time.

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The BDF answer to a special demand: Variable Gob Weight Servo Feeder

- Developed and tested in strict conjunction with the Technical Department of a world leader glass-maker Group
- Approved after 1 year of continued production tests.

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Productions suitable to use the new BDF V.G.W. Servo Feeder

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The BDF Variable Gob Weight Servo Feeder

Intended to be installed on those lines that can produce "mix of articles" in the same time.

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The BDF Variable Gob Weight Servo Feeder

- It's intended for the market of medium and small production series (typically for "special" bottle shapes);
- It runs as a V.G.W. servo feeder or as a normal one.

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The BDF's V.G.W. S.F. capabilities

The new electronic control allows to carry out, for every section, the following settings:

- Plunger: cam start, cam stroke, cam speed, cam profile, operating phase
- Shears: cam speed, cam profile, operating phase

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Benefit

- possibility to produce "just in time"
    - the scheduling of the production becomes extremely flexible;
    - quicker answer to the "last minute" customer requirements.
        - customer satisfaction

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Benefit

- possibility to reduce the storage time for some articles
    - some articles can be produced in the moment they are requested by the Sales Dpt.;
    - no worry to complete the mix on the IS or to satisfy the furnace pull .
        - money saving

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Benefit

- possibility to reduce the moulds maintenance
    - to compensate the article volume is now possible to adjust its gob weight without any mould adjustment;
    - job reduction in the moulds work-shop.
        - better article quality
        - time and money saving

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Benefit

- possibility to respect the "declared capacity"
  - in the "mixed" production each article can be produced following closely the "declared capacity";
  - the capacity settling is possible without any machine stop.
    - time saving
    - better article quality
    - customer satisfaction

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Benefit

- independent production scheduling
  - the article production became independent from the "weight grouping" arranged in the line
    - time saving
    - customer satisfaction

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Benefit

- possibility to reduce some article weight
  - when produced in "mix" the article weight can be adjusted to the effective requirement;
  - each article in the mix is independent from the others.
    - article cost reduction
    - customer satisfaction

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Benefit

- possibility to produce very quickly article sampling
  - it's possible to set a new weight in 1 or 2 sections while the others stay in normal production;
  - no machine stops are needed to reprogram the sample weight;
  - quick answer to the Customer and to the Sales Dpt.
    - customer satisfaction

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The normal gob cycle

- plunger cam time 'A' = plunger cam time 'B' = plunger cam time 'C' = …;
- typically the cutting time is during the plunger suction motion (offset between plunger and shears cams start; the gob diameter is decreasing);
- cutting time 'a' = cutting time 'b' = cutting time 'c' = …;
- the gob weight 'a_A' is proportional to the area with base the segment 'a and height included in the two plunger curves 'A' and 'B' (as parts).

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Plunger cam start modification

REAL effects of the increasing of the dead lower point in movement 'B':

- cam profile 'B' = cam profile 'A';
- increased press stroke in movement 'B' increased gob weight for gob 'b_BC';
- early stop of the press stroke in movement 'A' reduced gob weight for gob 'a_AB';

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Plunger cam start modification

In the video are shown gobs generated modifying the plunger cam start position.

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Plunger cam start modification: some results

IS machine: BDF, 8 sections, S.G., C.D. 4" ¼ Production weights: 650 gr, 600 gr, 545 gr
Weight difference: 105 gr on 600 gr = 17,5 %

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Plunger cam stroke modification

REAL effects of the increasing of the dead upper point in movement 'B' (max. position in suction motion):

- increased plunger suction movement gob weight 'a_AB' increased, gob weight 'b_BC' reduced.
- tested gob weight variation range in a 600 gr article: about 10%

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Plunger cam stroke modification: some results

IS machine: BDF, 8 sections, S.G., C.D. 4" ¼ Production weights: 625 gr, 600 gr, 570 gr
Weight difference: 54 gr on 600 gr = 9,0 %

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Shears cam start modification

REAL effects of the cutting time modification:

- increasing (delay, 'a'>'b'): gob weight 'a_AB' reduced and gob weight 'b_BC' increased of the same amount;
- decreasing (advance, 'b'>'a'): gob weight 'a_AB' increased and gob weight 'b_BC' reduced of the same amount.
- tested gob weight variation range in a 600 gr article: about 4%

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Shears cam start modification: some results

Weight difference: 22 gr on 600 gr = 3,7 %

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Production limits

Maximum weight variations obtained in production (on a weight of 600 gr) per each adjustment

- Gob too short
- Gob with extreme sharp point
- Gob falls out from vertical axis

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Example of production limit

In the video is shown the limit when gobs are generated modifying too much the shears offset: some of them are out of vertical axis.

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Production settings example nr. 1

- IS machine: BDF, 8 sections, S.G., C.D. 4" ¼
- 2 bottles in production: 550 gr, 450 gr
- Gobs sequence: A - B - A - B - A - B - A - B - ….
- Firing order: 1 – 5 – 2 – 6 – 3 – 8 – 4 – 7 -

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Production settings example nr. 2

- IS machine: BDF, 8 sections, S.G., C.D. 4" ¼
- 3 bottles in production: 525 gr, 510 gr, 505 gr
- Gobs sequence: A - B - A - B - A - C - B - C - ….
- Firing order: 1 – 5 – 2 – 4 – 3 – 6 – 8 – 7 -

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Operating Information

- the best operating solution is to have articles with the same weight on contiguous sections (e.g.: 3-3-2):
    - the proper firing order have to be found (BDF can supply a program to calculate it);
- according to the firing order:
    - the servo gob distributor could require a long jump motion (e.g.: a 7 sections jump);
    - a "dead plate error" for the pusher mechanism will arise;
- the articles on the conveyor belt will be mixed:
    - they have to be separated at the cold-end;
- as in any feeder:
    - the high quality control in the equalizing zone is a must (good glass homogenization).

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Required time for a gob weight change

Production line: IS machine 8 sections, Single Gob, mix of 3 different weights.

- 1 year of continued tests demonstrate that are required about 15 min to set 3 weights for the 1st time (the next time a job file can be loaded, cutting down the setting time).

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Tests on weights

To test the V.G.W. Servo Feeder behavior 2 types of tests have been performed:
- short period in steady glass conditions (10 machine cycles, all gobs checked);
- long period in steady glass conditions (2 hours, samples every 5 min, 2 sections).

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Weight test - type 1 (an example)

test in 10 machine cycles; all sections checked; weight A: 420 gr; weight B: 510 gr; difference A-B = 90 gr (by mean the plunger "dead lower point" modification); glass in steady conditions.
- A: best case min (max-min) = 1,6 gr
- A: worst case max (max-min) = 3,4 gr
- B: best case min (max-min) = 2,2 gr
- B: worst case max (max-min) = 2,6 gr

NOTE: in the standard feeder a weight variation of 2 - 3 gr between gobs was defined "physiological".

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Weight test - type 2 (an example)

test in 2 hours; samples: every 5 min; 2 sections checked; weight A: 420 gr; weight B: 510 gr; difference A-B = 90 gr (by mean the plunger "dead lower point" modification); glass in steady conditions; tube height setting after 90 min (normal procedure).
- A: max = 422,0 gr; min = 414,2 gr; max - min = 7,8 gr; std deviation = 2,17
- B: max = 509,2 gr; min = 501,4 gr; max - min = 7,8 gr; std deviation = 2,33

NOTE: in the standard feeder a weight variation of 2 - 3 gr between gobs was defined "physiological".

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Test still running

Performance in D.G.:
- under test with positive results;
- because of the glass motions inside spout, 2 plungers with independent height settings seem to be required to adjust the Int. and Ext. gob weights.

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Just one comment from the user

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The interest for this new technology

- This new technology meets with outstanding success.
- Here is shown the visit of Mr. N. Yamamura (C.E.O. of Yamamura Glass Works Co.) and his technical team as special guests in the glass factory to visit the BDF's V.G.W. servo feeder.

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The system composition

BDF Servo Feeder mechanism (mechanically enhanced);
Electric Cabinet for logic and power;
Intelligent External Control Box;
Graphic Hand Terminal;
Main Operator's Console.

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The system layout

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Servo Shears position accuracy

the shears position mechanical accuracy is better than 0,03 mm.

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Servo Plunger position accuracy

the plunger position mechanical accuracy is 0,02 mm.

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Servo Plunger data page

- all sections with the same settings;
- every section with different settings.

Slide nr. 45

Servo Shears data page

- all sections with the same settings;
- every section with different settings.

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State-of-the-art in the software

An "easy-to-use" Cam-Maker program allows the operator to adjust the motion profiles to the production requirements.

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Thank-You for your kind attention.