Monitoring problematic fabricating debris defects on tempered glass surfaces

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Keywords

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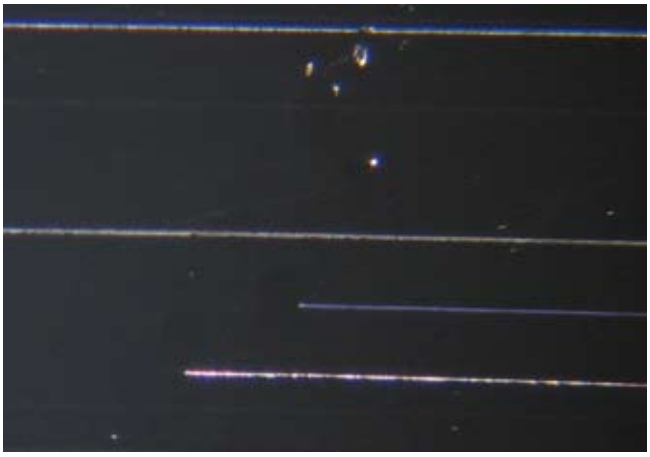
In horizontal glass tempering processes, the ceramic rollers are in intimate contact with the glass, and the condition of ceramic rollers is directly associated with glass surface quality. The condition of rollers is directly affected by proper glass washing to thoroughly remove fabricating debris. The author discusses how excessive fabricating debris defects can cause visible scratches during cleaning, and illustrates how readily these fabricating debris scratches are distinguished from scratches caused by mortar, rocks, sandpaper, etc..

The author proposes a simplified surface quality test for fabricators to predict tempered glass performance during future cleaning to remove stickers, paint, and other persistent debris. This test employs a common shop microscope to observe the result of simulated cleaning of uncoated glass with common metal razors, such as those widely used by fabricators to remove stickers and sealant debris."

Figure 1

The roller side of this scratched tempered glass may have had over 500,000 microscopic fabricating debris defects.



Introduction

When a window cleaning scraper encounters a solitary fabricating debris defect, there are a number of possible outcomes. Depending on random factors such as size and shape, the defect may be passed over without incident, or the defect may be dislodged, but remain free. The defect may be dislodged and trapped in such a way that it causes a scratch that's invisible to the naked eye – or it may create a deeper furrow that will glisten in the right light.

That solitary scratch may or may not objectionable.

Even though the defect shouldn't be there, we realize glass is not perfect. Unfortunately, poor quality tempered glass is far from perfect. When an astronomical number of fabricating debris defects is present, even a small percentage of "perfect" defects create an alarming number of visible scratches during cleaning. It stands to reason that excessive levels of fabricating debris defects cause more issues for fabricators, their customers and end users, and the way to minimize the issue is to minimize the defect.

At least 11 microscopic defects are visible in Figure 1 - in a field of view smaller than 5mm square, For a tempered lite the size of a GPD poster (1m x 1.2m2) that would project to 528,000 defects. (The author does not suggest this represents the lowest quality possible.)

There is always room for improvement, and we all realize that, but how can this be measured? How can the temperer know whether or not their production quality objectives have been met? How do managers, furnace operators and quality controllers monitor the results of their own efforts?

We propose a very simple and very realistic method for monitoring problematic fabricating debris defects on tempered glass surfaces – periodic use of a window cleaning scraper on free tempered glass to simulate future cleaning to remove stickers, paint, and other persistent debris.

The need for monitoring if tempered glass surface quality is questionable;

- Lack of data fuels speculation and/or suspicion
- Inability to resolve surface quality issues.
- Disputes consume managers personal time and energy
- Legal fees may rise
- Energy, transportation and other costs of rework
- Organizational impact of rework
- Customers have problems meeting deadlines
- Customer concerns about brand quality

The need for monitoring when the temperer has maintained high quality standards

- Unable to market the advantages of quality tempered glass surfaces
- Can't capitalize on demand for durable, easily maintained products
- Can't capitalize on demand for green cleaning if toxic chemicals are recommended
- Competition claims your quality tempered glass surfaces are no better than their brands.
- Customers needlessly concerned about quality of your brand.
- Customers can't distinguish between brands

There will always be demand for glass that can be cleaned with scrapers, because there really are no safe, practical, effective alternatives.

Objective

This test simulates the standard cleaning method of using a scraper to thoroughly remove paint, stickers, etc. The objective is to gauge surface quality and predict whether tempered glass would scratch during cleaning at some point in the future, by periodically attempting to cause fabricating debris scratches, using a window cleaning scraper.

Any scratches will be observed with a common shop microscope, and a log kept.

Equipment

- Felt tipped marking pen
- Straight edge
- Lighted shop microscope – 40x or 60x
- Conveniently located testing area
- User friendly worksheet or spreadsheet to log results.
- 6 inch glass cleaning scraper such as the Triumph MK3. [Figure 2]
- A common 1-1/2 inch retractable scraper, may be used, but will require 4x as many passes to cover the same 6 wide inch area.

Figure 2

Professional 6 inch window cleaning scraper (Triumph MK3 from JBF)

Method

Obtain test lites at furnace unload station label each with relevant information such as date and time, and remove to test area.

Turn tempered glass over, so the roller side is on top, and begin testing for fabricating debris defects promptly, while the glass is still clean.

Draw two parallel lines with a felt tipped marking pen 6 inches apart, from one edge of the glass to the other. Place the 6 inch scraper between the lines, near one edge of the glass.

Apply pressure, and move the scraper across the glass. Stop before reaching the opposite edge.

Figure 3a

Even with a shop microscope, these scratches are invisible in poor lighting

Figure 3b

When light source is perpendicular to the scratch, the scratch becomes visible.

Figure 4

Fabricating debris defects cause fewer scratches near the beginning, and more scratches near the end

Results

- Draw an x at one point along one of the drawn near the end where the scraper stopped.
- Place the shop microscope over that point.
- Turn on the light, and rotate the scope so that the light is parallel to the line.
- Focus the shop microscope on the ink mark.
- Move the shop microscope slowly from one line to the other.
- Count all scratches that can be seen, and enter the result in the log.
- Draw another x at another point along the line, use the shop microscope to repeat these observations, and log the result.
- Keep the light perpendicular to the scratches at all times. Figures 3a & 3b show the dramatic difference proper lighting makes.

Comments

This test would be performed periodically - with frequencies subject to local conditions – and after events that might affect surface quality, such as equipment maintenance.

Testing procedures should specify the position of samples entering the oven in order to monitor the entire usable width of rollers.

Soap and water are typically recommended when scrapers are used, but they are not used for this simulation because soap residue may interfere with observations – and because the glass is already clean.

When any noteworthy defect or features are found, the location can be saved for future reference by tracing a circle around the base of the shop microscope with the felt tipped marker. It may be difficult to focus the shop microscope on a clean, unscratched surface. In that case, focus on an ink mark.

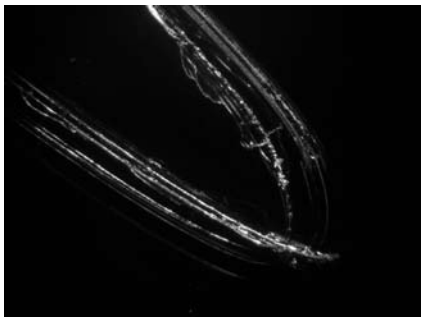


Figure 5a

Scratch caused by a rock.

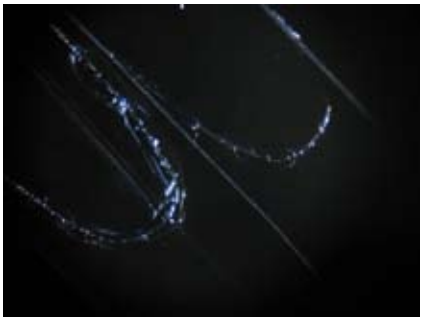


Figure 5b

Scratch caused by sandpaper.

When scratches are being counted and logged, these observations must be made in the area near where the scraper stopped; most scratches end there, regardless of length. [Figure 4]

Training

Train using stickers, tape, or paint, but do not use them during the cleaning simulation.

On poor quality tempered surfaces, quality control personnel will observe more defects than scratches, and will observe more microscopic scratches than visible scratches. On quality surfaces, defects will be scarce,

microscopic scratches will be rare, and visible scratches rarer still.

When a poor quality tempered lite is not available for training purposes, and cannot be obtained from a competitor, it is suggested that a rock or a piece of sandpaper be used to create scratches which can be viewed with the shop microscope. Note that when scratches are caused by other than fabricating debris defects, irrelevant features will be observed, such as curves, crush marks, sharp turns. [Figures 5a and 5b]

Conclusions

Simulated scraper cleaning is a practical shop test for the very reasons it is not practical as a field test; the glass is free and can be easily maneuvered i.e. placed on a table, the glass is already clean, and lighting can be readily controlled. Because a large area can be scraped in the shop and observed with a powerful shop microscope, results will be much more reliable than any field test involving mere visual inspection of a "small, inconspicuous area".

The cost per square foot for periodic monitoring by current QC staff will be minimal compared to other costs. Where feedback results in a renewed emphasis on plant cleanliness tempering practices and equipment maintenance, those costs would be recoverable through sustained productivity and extended useful life of equipment.

Summary

The scraper cleaning simulation can put an end to uninformed speculation about the relative quality of tempered glass, while increasing organizational awareness of the consequences of excessive levels of fabricating debris defects on poor quality surfaces. The cost of monitoring would be negligible in comparison to the costs involved in scratched glass claims.

Timely feedback will enable the fabricator to maintain - or improve, as the case may be – the quality of tempered glass surfaces, because forensic methods such as optical microscopy, scanning electron microscopy, and energy dispersive spectroscopy are available to resolve defects.

Author

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Numerous GPD articles at www.glassfiles.com relating to tempering quality issues, including;

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