

How to Make a Residue-Free Particle Disperser

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One of the basic tools that a particle analyst needs during microscopical research is a particle disperser, which is used to gently crush and then disperse particles between a microscope slide and coverslip (1). The standard tool employed for this purpose in many laboratories is the soft eraser on typical graphite ("lead") pencils or a pencil with two erasers (2).

These pencil erasers are soft enough to gently dissipate the pressure applied to the preparation and stiff enough to make brittle particles break. But, of course, their intended purpose is to rub away graphite and/or ink from paper or other (mostly cellulosic) surfaces. Therefore, erasers' rubber ingredients (including mineral fillers, plasticizers, vulcanization aids, antioxidants, etc.) are optimized primarily for this purpose. However, when erasers are used as particle dispersers and pressed onto an optically clean glass surface, like a coverslip, most of their rubber constituents leave residues that smudge glass surfaces and diminish the quality of microscopical images; they may even become a potential source of sample contamination.

This article compares some commonly available pencil erasers and block erasers with respect to the amount and nature of residue that they leave on glass surfaces when used as pressing tools. It also describes modifications made to two of the tested erasers intended to help reduce smudging.

Table 1 lists a selection of eraser-tipped pencils and block erasers that were tested for this study. The

list is by no means comprehensive and covers only a small selection of erasers that were readily available to the author.

The individual test specimen was used in such a manner that a freshly cut surface (obtained with a scalpel blade) was pressed once firmly by hand against a clean microscope slide at room temperature. Any remaining residue on the glass was assessed with the naked eye first, then with a stereomicroscope and polarized light microscope. All tests were performed on a single microscope slide by pressing the rubber surfaces, side by side, near pre-numbered positions to distinguish the pencils and block erasers.

Test pencils Nos. 4 and 5 (see Table 1) were modified by immersing their erasers in a diluted solution of flexible collodion (No. 4) and rubber cement (No. 5) (2). The films that formed around these erasers were then dried for > 24 hours at room temperature.

A final visual comparison of the residues left behind by the erasers was then performed with the stereomicroscope to determine how much residue was left on the glass slide. Residue amounts were ranked by letters A to L, with A representing the best result, i.e. least amount of residue. Table 2 summarizes the test results.

It was clear that the flexible-film-covered pencil erasers (Nos. 4 and 5) yielded the best results. The flexible polymer films coating the top of the rubber elastomers of these two pencils protected the glass surfaces from the erasers' native ingredients. The Microtrace,

Table 1. Pencils and Erasers Tested in This Study

Item No.	Pencil/Eraser Description and Comments
1	Penway No. 2 pencil, distributed by East West Distributing Co., Deerfield, IL; made in China.
2	PaperMate Mirado Black Warrior No. 2 HB pencil with Pink Pearl eraser, Oak Brook, IL; made in U.S.
3	Faber-Castell Castell 9000 HB pencil, Nuremberg, Germany; made in Germany.
4	Faber-Castell Castell 9000 HB pencil, Nuremberg, Germany; made in Germany. Extra treatment: pencil eraser covered with thin film of flexible collodion.
5	Faber-Castell Castell 9000 HB pencil, Nuremberg, Germany; made in Germany. Extra treatment: pencil eraser covered with thin film of Elmer's No-Wrinkle Rubber Cement.
6	Faber-Castell GRIP 2001 2½ = HB pencil, Nuremberg, Germany; made in Germany.
7	Microtrace, LLC double-sided eraser pencil, Elgin, IL. Custom made; based on a woodcase pencil.
8	Pelikan PK 20 ink and pencil block eraser; made in Germany. White side used for testing.
9	Läufer PLAST-0140 block eraser; made in Germany.
10	Faber-Castell DUST-FREE 18 71 20 block eraser; made in Malaysia.
11	Staedtler Rasoplast Combi block eraser, latex-free; made in Germany. White side used for testing.
12	Faber-Castell GRIP 2001 Eraser Cap; made in Malaysia.

LLC particle disperser, a pencil with two erasers (No. 7), performed the best among all untreated, ready-made products tested.

Figures 1, 2 and 3 depict the residues left behind from pencil eraser Nos. 1, 6 and 7, respectively. The photomicrographs were taken using extremely oblique incident light illumination ("grazing angle illumination") with a gooseneck fiber optic illuminator, using a stereomicroscope with one eyepiece removed and replaced by an ocular projection CCD camera. The black background was obtained by matte black paper inserted underneath the slide.

Figure 4 depicts a photomicrograph from the perimeter region of the residue left behind from pencil No. 1, taken in transmitted polarized light with crossed polars. An enrichment of larger birefringent particles alongside the perimeter of the circular impression is clearly seen. The birefringent particles observed are, in many cases, expected to be inorganic filler minerals that are part of an eraser's rubber ingredients.

As a result of this study, the author recommends sealing pencil erasers to be used as particle dispersers with either a dilute solution of flexible collodion

or rubber cement and then allowing them to dry at room temperature. Sealing pencil erasers in this manner is beneficial because fewer image distortions will appear during microscopical observation and the risk of sample contamination is reduced.

Following is a list of equipment and materials used for this study:

- Carl Zeiss Jena (CZJ) TECHNIVAL (binocular stereomicroscope, ring light attachment and transmitted light stand, external cold-light source with a gooseneck fiber optic illuminator), and CZJ P 10× (20) eyepieces
- Carl Zeiss Jena AMPLIVAL pol u (petrographic, binocular-transmitted and incident-light instrument for polarized light microscopy), CZJ 4×–63× objectives, planachromates (pol), and PK 10× (15.5) eyepieces
- TCA CMOS/CCD 5.0 MP digital microscope camera with picture capture and TSView 7 processing software from Fuzhou Tucsen Imaging Corp.
- Euromex EK-1 cold light source, with a double gooseneck fiber optic illuminator
- Elmer's No-Wrinkle Rubber Cement
- Sigma-Aldrich collodion solution for microscopy

Table 2. Observations of Residues from the Pencils and Erasers Tested in This Study

Item No.	Rank	With the Naked Eye, in a Specular Reflection Position	With Stereomicroscope, 16x	With Transmitted Polarized Light Microscope, 63x
1	E	Circular mark, slight residue	Oily droplets; particles at circumference of mark	Oily droplets confirmed; many birefringent particles
2	K	Circular mark, heavier residue	Oily droplets; particles at circumference of mark; heavier effects as in No. 1	Oily droplets confirmed; many birefringent particles
3	L	Circular mark, bold residue	Oily droplets; particles at circumference of mark; even heavier effects as in No. 2	Even larger oily droplets confirmed; many birefringent particles
4	B	Circular mark, slight residue	Bubble/foam-like pattern of mark	Few oily droplets; almost no birefringent particles
5	A	No mark, no residue	Very faint residue	Almost nothing visible
6	D	Triangular mark, slight residue	Heavy, oily droplets	Many oily droplets; birefringent particles
7	C	Circular mark, slight residue	Faint residue, dry	No oily droplets; many very tiny particles, some birefringent
8	F	Irregular mark, visible residues	Heavier residues	No oily droplets; many very fine particles, some birefringent
9	G	Irregular mark, heavier residue	Heavier oily droplets	Oily droplets; some birefringent particles
10	H	Irregular mark, heavier residue	Heavier oily droplets	Oily droplets abundant; some birefringent particles
11	I	Irregular mark, heavier residue	Coarse, oily droplets	Many oily droplets; lots of birefringent particles
12	J	Irregular mark, heavier residue	Abundant oily droplets	Oily droplets; few birefringent particles

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1. McCrone, W.C. "Particle Characterization by PLM, Part I: No Polars," *The Microscope*, 30:3, pp 185–196, 1982.
2. McCrone, W.C. and Johnson, R.I., eds. *Techniques, Instruments and Accessories for Microanalysts: A User's Manual*, Walter C. McCrone Associates, Inc.: Chicago, p 5, 1974. ■

See Figures 1–4 on page 44.

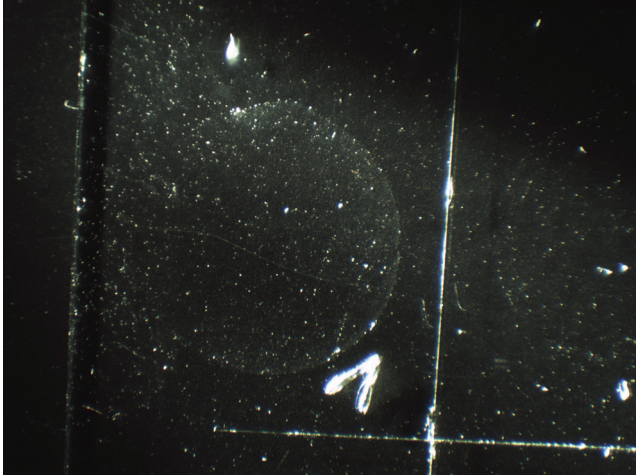


Figure 1. Residues from pencil No. 1; grazing angle brightfield illumination, stereomicroscope.

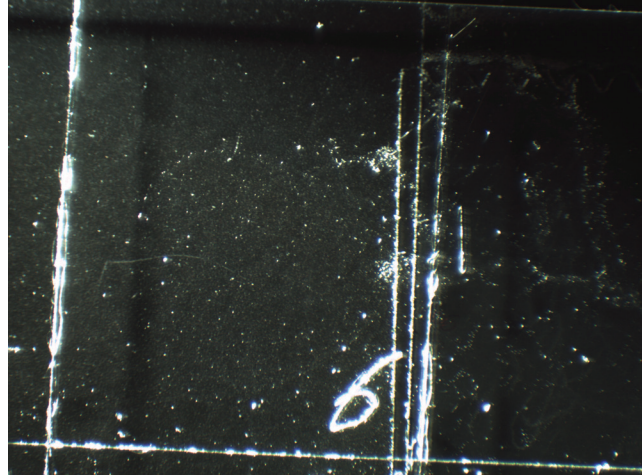


Figure 2. Residues from pencil No. 6; grazing angle brightfield illumination, stereomicroscope.

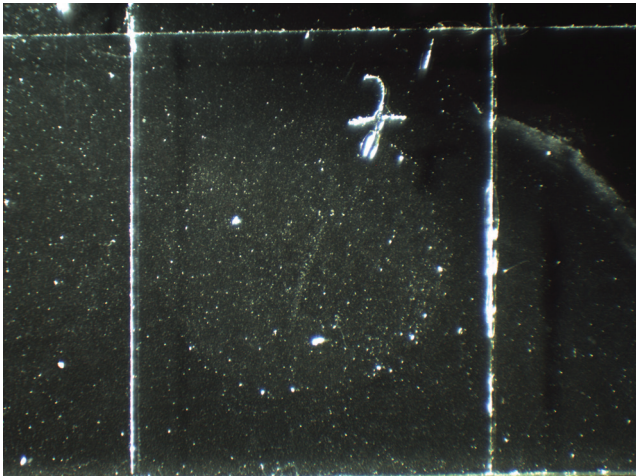


Figure 3. Residues from pencil No. 7; grazing angle brightfield illumination, stereomicroscope.



Figure 4. Residues from pencil No. 1; transmitted polarized light, crossed polars.