REVEALING OIL SPOTS

Carleen Devine

The elusive oil spot glaze has fascinated me for many years. After seeing superb examples in Japan and occasionally experimenting at home, I decided to make this a project for my Diploma course at Brookvale TAFE. My thanks go to Chris James for his supervision and continued interest in this journey.

Exactly what are “oil spots”? Joseph Grebanier\(^1\) gives a clear explanation of how oil spots are created:

The oil spot phenomenon is manifested as a great number of bright, round, silvery spots of varying sizes that appear to be floating on the surface of the brown-black glaze matrix. These spots are created in the course of the firing of the glaze by a series of developments:

1. Bubbles rising through the molten glaze reach the surface and burst there, leaving pits or craters in the surface at those points.

2. As the firing continues, the more soluble and therefore more fluid, extra iron-rich portions of the surrounding glaze pour into these pits and fill them before larger-particled, less soluble portions of the glaze can move to them.

3. As a result, when the firing is concluded at just the right stage, the pits are more or less filled with the extra iron-rich glaze material that has crystallized into patterns which are more reflective of light than the rest of the glaze.

It is interesting and instructive to observe, with the aid of a magnifying hand lens, that the entire surface of such a glaze is actually still quite bumpy with only partly smoothed-over pit edges; even more interesting, each seeming oil spot is formed by grayish metallic streaks or lines that radiate outwards in a crystalline pattern from a central point to the limits of the former pit. Similar examination of the same glaze fired to a higher cone reveals the disappearance of both the pits and the crystals, resulting in a black or brown glaze without oil spots. The additional liquefaction of all the glaze material at a greater work-heat has thus produced a more uniform mix of the molten glaze and has thereby erased all distinction between the matrix and the pits holding their special iron-rich material.
John Britt is well-known internationally for high-fire glazes. His technical description of the oil spot process is:

*It may be that the oxidation of a temmoku firing resulted in the discovery of the first oil spot glazes. The natural spotting of the iron and the resulting silvery iron crystals make for some interesting and beautiful glaze effects. Oil spot glazes are high in alumina and silica, relatively high in potassium oxide and magnesium oxide, and are fired in oxidation atmospheres.*

Oil spots work on a very simple principle. If iron oxide (Fe2O3) is fired in a reduction cycle, it will reduce to FeO from gases in the kiln atmosphere. But if red iron oxide is fired in oxidation, it will remain in that state until the temperature rises above 2250°F (1232°C), when it will then be reduced to the less complex form (FeO) naturally by the action of heat alone. The complex molecule of Fe2O3 simply cannot maintain its state at those temperatures. It will release an oxygen atom that will bubble to the surface of the hot glaze and pull a bit of iron oxide with it. When it reaches the surface, the oxygen releases the iron as it leaves the glaze, creating areas with greater concentrations of iron oxide. In order to produce oil spots you’ll need a glaze base that is viscous enough to hold the iron spot but not so viscous that it prevents the oxygen bubbling through it.

**ORIGIN**

Nigel Wood outlines the earliest history of oil spot glazes discovered at the Jian teabowl kilns. This was during the Song dynasty (960-1279), which marked a high point in the history of Chinese pottery.

*Bowls with streaky 'hare's fur' glazes are by far the commonest type of Jian temmoku ware, but it happened occasionally that kiln temperatures began to fall while the glazes were still boiling, thereby fixing the iron-rich spots before they could run down into streaks. Occasionally these spots crystallised as magnetite, giving silvery spots on a black background – the celebrated “oil spot” effect. Bowls with true oil spot glazes from the Jian kilns are extremely scarce and much sought by collectors. Interestingly, the effect was copied in north China (a major market for Jian wares) in the Song and Jin dynasties – using a more reliable technique that involved the application of an iron-rich (and perhaps magnetite-based) slip beneath an ordinary black temmoku glaze. The success of this approach has meant that northern oil spot temmokus are less uncommon than the Jian originals.*
Tea bowl, Jian-type stoneware with oil-spot effect (yohen temmoku) from Fujian province, 12th–13th century, Southern Song dynasty; in the Seikado Bunko Art Museum, Tokyo. © The Seikado Bunko Art Museum

Bowl with “Oil-Spot” Design, Jin dynasty (1115-1234)
Metropolitan Museum of Art, New York
© www.metmuseum.org

OIL SPOT RECIPES

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<tr>
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<th>Carleen’s oil spot</th>
<th>Daly’s oil spot</th>
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<tbody>
<tr>
<td>Potash Feldspar</td>
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<tr>
<td>Iron Oxide</td>
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<tr>
<td>Cobalt Carbonate</td>
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At the outset of this research, I accumulated as many recipes as possible and tested approximately ten of them, including Harry Memmott oil spot, SG12 oil spot, and Britt’s Candace, John’s and No29 oil spots.

Carleen’s oil spot was chosen from a biaxial test with the limits for alumina and silica set in accordance for oil spots in John Britt’s graph above. Daly’s oil spot showed consistently good results in early testing. I therefore continued testing on just these two recipes. Line blends with red iron oxide, cobalt carbonate and calcium/magnesium showed that:
• 6-8% red iron oxide gave the best results - pinholes and metallic surfaces occurred with increasing the amount of iron above this.
• Cobalt carbonate over 5% caused pinholes and dull metallic surfaces – approximately 1.5% gave well defined spots in a glossy black base.
• A ratio of 1 part magnesium to 10 parts calcium carbonate appears necessary to create oil spots.
• Magnesium will assist in smoothing.

Harry Memmott states: *If there is an excess of calcium the boiling effect will be reduced and the glaze will become a black temmoku. A substantial percentage of alumina and silica may be used. It is good practice to calcine any talc or the major portion of kaolin if used in this glaze.*

Ian Currie states: *The glaze must contain enough Fe₂O₃ so that not all is taken into solution as the glaze melts. It is the “left over” iron that decomposes. It is necessary therefore to have a base glaze which favours the iron not dissolving in the glaze. .... this will mean high alumina and silica and high alkali with low calcium (since calcium is very effective in dissolving iron). A high feldspar content contains these requirements. To get the glaze to melt and smooth over at stoneware temperature, a little Ca and Mg are necessary. The iron oxide must be as pure as possible.*

However, of the glazes tested, Carleen’s and Daly’s oil spots ranked lowest on KNO content. Daly’s oilspot also ranked lowest on Al₂O₃ and SiO₂, and ranked highest on Mg and CaCO₃.

**SPECIFIC GRAVITY**

A range of specific gravities was tested, along with varying dipping times. The glaze needs to be applied thickly and flocculation with calcium chloride assists this. The raw glaze dries slowly and tends to peel off the pot during the drying period where the specific density is above 1400 (see photo).

The test which varied specific gravity from 1300 to 1500, showed that SP1400 with a 10 second dip gives a good cover and yields fine even oilspots. At lesser specific gravities, the oil spots are miniscule, if there at all. Above 1400 there is often crawling, pinholing and pooling to form metallic cratering.

Calcined talc was used to lessen the chemically boded water in the glaze and minimise the H₂O when applying the glaze. Calcining the kaolin may also assist in this.

Grebanier discusses glaze application and emphasises that there needs to be as little water as possible to prevent crawling. He states: *Ironically, the parts that do peel, in such instances, fold over onto other glaze portions, and because of the thereby multiplied thicknesses of the glaze at these point, develop handsome, large oil spots! The only trouble is that these passages directly adjoin ugly bald spots.*
FIRING

The firing method is critical to the production of a good oil spot glaze and the ceramists’ views on firing vary.

Grebanier’s firing procedure is to fire, in an oxidizing atmosphere, to no more than cone 8 and soak for about three-quarters of an hour.

Britt’s oil spots are fired in oxidation to cone 10 or 11 or high to adequately melt the glaze. He states9:

*Larger oil spots result when you extend the firing time between cone 7 and cone 10 to more than five hours, which allows the iron more time to release oxygen. If the firing is extended too long, though, the surface will be covered with iron spots, making it metallic.*

Various articles suggest refiring in either oxidation or reduction to smooth out unhealed glaze surfaces; going into reduction after cone 7 in the initial firing; soak but not at top temperature; slow cooling.

In conclusion, the selection of the firing regime can only be achieved through continual testing and differs for each oil spot glaze recipe.

Carleen’s and Daly’s oil spot glazes have different firing regimes.

(1) Carleen’s oil spot is fired to cone 10 and soaked at cone 10 for half an hour. This achieves a glossy black base with fine, well-formed silver oil spots. The soaking period smooths out most of the fine pinholes which were present in earlier tests without a soak, but does not eliminate the spots. The addition of cobalt carbonate gives the midnight black base.
Daly’s oil spot is fired to cone 8½ without a soak. This firing yielded an exceptionally smooth satin, rather than glossy, glaze surface, with well-formed fine oil spots and no pinholes. The recipe does not have cobalt carbonate, so is brownish-black in colour.

In both firings the rate of climb was 100° per hour to 1200° and then 30° per hour until the cone temperature was achieved. The other oil spots initially tested showed a variety of rough surfaces, pinholes, craters and metallic pooling. Possibly many of these faults could be overcome by developing specific firing regimes for each glaze.
1 Grebanier, J *Chinese Stoneware Glazes*, Watson-Guptill Publications, New York, 1975 (p.84)
4 Daly, G *Glazes and Glazing Techniques*, Kangaroo Press Pty Ltd, Kenthurst, 1995
7 Currie, I *Stoneware Glazes, a Systematic Approach*, Bootstrap Press, 1985 (p.166)