The Good Oil

… what really happens when you oil your recorder?

Terry Simmons

Having invested a very significant amount of money in a new wooden instrument, any recorder player, amateur or professional, should be keen to protect that investment by providing proper care.

Oiling, an important aspect of care, ought to be a simple matter. But the recorder player is faced with such conflicting information from instrument makers and from independent writers on the subject that it is difficult to be confident that the correct methods are being used.

Careful reading reveals that there are two clearly identifiable schools of thought on the oiling of recorders. They can be characterised as follows:

- Use plenty of oil, even going as far as total immersion (with the block removed). Use it as often as once a week.
- Use oil very sparingly. Oil infrequently - about twice per year is plenty.

There is little consistent advice about the choice of oil, a confusing variety (linseed, banana, peanut, coconut, almond, olive, etc.) being recommended by different writers.

The recorder player really needs to know what is the best oil to use, how much to u se, how often to use it and how to apply it. To answer these questions it is useful to know a little about oils, and the things that happen when we oil a recorder.

Let's have a look at the nature of oils. What is it that makes them "oily"? What are the particular properties of oils that make them suitable for treating woodwind instruments? And what is the purpose of applying them in the first place?

A Short Chemistry Lesson

Fats and oils are water-insoluble substances originating in plants or animals, and consist predominantly of triglycerides or "fatty acids"[1]. These are very complex molecules, based upon three long chains, each consisting of usually about 18 carbon atoms trailing out from a central linking point called the triglyceride link.

Diagrams 1 and 2 shows the way chemists represent the individual building blocks that make up these long chains. The letters C and H represent atoms of carbon and hydrogen respectively. Whilst each hydrogen atom has only one "hand" to link itself to other atoms, each carbon atom has four such "hands" available. This enables carbon atoms to connect into long chains, like pearls on a string, and still have a couple of "hands" left over to link up sideways with other atoms. The longer the chains, the more likely they are to become entangled with other chains, and the thicker and more viscous the oil. (As will be explained later, the interaction between wood and oil is confined to the surface of the wood, so viscosity is not important to the present discussion.)

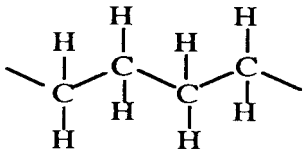


Diagram 1: Carbon chain in a saturated molecule.

If every carbon atom in the chain is attached sideways to two hydrogen atoms, as in Figure 1, the chain is said to be saturated. That is, it couldn't accommodate another hydrogen atom if it wanted to. In many cases, however, there is a double link between two carbon atoms, as shown in Diagram 2. When double links occur, the chains are called unsaturated. These double links (also called unsaturated centres) are extremely influential upon the oil's chemical properties.

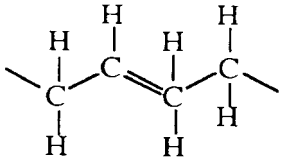


Diagram 2: Carbon chain in an unsaturated molecule.

Because oils are naturally occurring substances, they are not pure chemical compounds but mixtures of many different compounds. Vegetable oils are typically made up of a mixture of saturated and unsaturated oils, their proportions influencing the oil's properties.

The carbon atoms in saturated chains are fully occupied, so to speak. Therefore, oils that are composed mainly of saturated chains are stable and inert. They tend to be unaffected by exposure to air or to other chemicals. The situation is quite different for the unsaturated chains, however, because the double links form "activity sites" where chemical reactions can and do take place quite readily. For this reason, unsaturated oils are much more chemically active, and much less stable when exposed to air. For example, unsaturated chains will react with the oxygen in the air, a process known as "oxidisation".

This is responsible for the rancid taste and smell that develop in fats and oils (usually in edible fats and oils, which will not concern us here), and it is also responsible for the phenomenon of 'drying' of particular oils used in the manufacture of linoleum and paints.

When some oils are applied to a surface, the applied film changes gradually from a liquid to a firm, tough and durable solid. The phenomenon bears a superficial resemblance to the change occurring in a water-based solution when the water evaporates, and hence has been termed "drying". Actually, the term is a misnomer. The essential process in the transformation of the film is polymerisation, which is discussed below.

Oils that behave in this fashion are termed drying oils, and the drying power of the oil increases with the degree of unsaturation. This property is so important that at one time it was used as the basis for classification of oils, which were categorised as drying, semi-drying or non- drying.

Polymerisation

The film-forming properties of the drying oils are closely related to their degree of unsaturation, since it is through the unsaturated centres or double bonds that polymerisation takes place. In polymerisation, most of the action takes place in the region of the double links. The oxygen from the air moves into the region of the double link, prising one of the links apart and attaching itself to the carbon atom. This now means that the long carbon chains are able to form links across from one chain to another, forming a three- dimensional, solid substance. Once this cross- linking starts to occur, the oil fairly quickly becomes solid, with any saturated-chain oils (which do not take part in the polymerisation process) becoming trapped in the cross-linked "web" of polymerising oil. The result is a tough gel or resin.

Anyone who may have wondered about the "resinating plant oil" recommended by Rowland-Jones[2] now has an explanation for the term.

The Iodine Number

The more unsaturated an oil is, the better its ability to polymerise This being the case, it is not surprising that chemists have developed experimental techniques to measure the degree of unsaturation of oils. The Iodine Number is a measure of the degree of unsaturation, and is the number of grammes of iodine absorbed by 100 grammes of the oil. Highly unsaturated glycerides such as linseed oil and tung oil have an iodine number from 180 to over 200. Glycerides with a lower iodine number in the range 100 to 120, such as cottonseed oil, are called semi-drying oils. These thicken in air but do not form a skin. Non-drying oils such as olive oil (iodine number 85) have iodine numbers well below 100.

Table 1 lists Iodine numbers[3] for some fairly readily available vegetable oils. In this list, only Linseed Oil and the rarely encountered Tung Oil are drying oils; the others are either semi-drying or non-drying. All those marked with an asterisk (*) have been recommended by one writer or another for oiling recorders.

Oil	Iodine Number
*Coconut Oil	7.5 – 10.5
Palm Oil	44 – 58
*Olive Oil	80 – 88
*Peanut Oil	84 – 100
*Almond Oil	93 – 106
Rapeseed Oil	97 – 108
Cottonseed Oil	101 – 109
Sunflowerseed Oil	113 – 140
Tung Oil	160 – 175
*Linseed Oil	165 – 204

Table 1: Iodine Numbers

It will be noted that this table does not include *Banana Oil*, which is occasionally recommended for recorder oiling. I have neither been able to purchase Banana Oil nor to locate information about its properties, so I have been forced to omit it from this discussion. However, the name "Banana Oil" unfortunately refers to two very different substances - and the difference is very important! Banana Oil may be used as the name of an oil extracted either from bananas or some other part of the banana plant, in which case it may possibly be suitable for oiling recorders. (However, in the absence of an Iodine number, one would not know the correct way of using it.) There is also a chemical compound, Isoamyl Acetate, which is commonly referred to as Banana Oil or Pear Oil, mainly because of its odour. It is used in manufacturing industry for a wide variety of purposes - mainly as a solvent with a pleasant odour. It is a pure chemical called an ester, with a very small molecule (only seven carbon atoms) and no triglyceride link. It is **not an oil**, possessing none of the characteristics described earlier. It should not be brought into contact with your recorders.

How does oiling change the instrument?

The appearance of woods is determined by its grain, its texture and its figure (which generally arises through irregular patterns of pigment). The texture of wood is determined by its cellular construction. This can be thought of as consisting of tiny cells of cellulose "glued together" by a substance called

lignin. This is a bit like a brick wall, which consists of lumps of clay "glued together" by mortar, with the important difference that the wall is only two-dimensional whereas the wood is three-dimensional. As a generalisation, the cellulose loves water but hates oil, whereas lignin likes oil but hates water. When oil is applied, it is ignored by the cellulose but attaches itself to the lignin, by a process of wetting rather than chemical bonding. This means the attachment is quite weak. It is important to realise that the attachment between oil and lignin occurs only at the outer layer of cells. There is no real question of the oil being "absorbed" to any real extent. Any impression that the oil has penetrated or that it has been absorbed by the wood is merely an illusion resulting from the oil drying.

If a non-drying oil is used, the only oil that will survive on the instrument after a few swab- outs will be oil that is sitting in depressions or pores in the surface of the wood. (In the very smooth woods used in recorders, that won't amount to much!) The oil will occupy the pores and thus inhibit the entry of any liquid water that forms in the bore.

If a drying oil is used, the situation is far different. The first application of oil will leave a tough film of polymer attached to the lignin. The next layer will attach itself to the first layer, and this process will continue with successive oilings. If there are any fine fibres of wood remaining in the bore after the instrument's manufacture, they will become coated with the oil, and will then become brittle as the oil solidifies. When the bore is swabbed out, these fibres will be broken off and removed, helping to smooth the bore surface. Over many years of oiling there will be a very gradual build-up of a tough, smooth coating that will be impervious to liquid water but which will permit relatively free passage of water vapour between the atmosphere and the cellulose cells – a desirable situation, as it allows the recorder to adjust to climate and weather changes as well as the moisture changes encountered when the instrument is being played. Successive cycles of oiling and swabbing over several years will produce a high level of polish in the bore, and this will have a subtle effect on the recorder's timbre, as the hard, clean, smooth reflecting surface will encourage the formation across the instrument's diameter of standing sound waves which, in combination with those standing lengthways in the instrument, contribute to the sound character of the instrument. Is this a positive or a negative contribution? That is of course a matter of opinion, but it is significant that at least three of to-day's most respected recorder makers take the trouble to smooth and finish the bore of all their instruments with a durable, hard varnish so that it looks like a gun barrel - so they must consider it a positive contribution!

It seems reasonable to conclude that if the maker has already produced this kind of finish in the bore, it may be unnecessary to provide additional coatings by using a drying oil. In such cases, it is probably sensible to apply a non-drying oil occasionally, just to keep the bore dean. By the same token, if the maker has supplied the instrument with the bore unvarnished, a sensible strategy is probably to apply films of a drying oil such as linseed, repeated six-monthly over several years with polishing, until a shiny protective coating has been produced. At this point, the bore has considerable protection, and from this point onwards a non-drying oil could be used, again merely for the purpose of cleaning the bore.

Now that we have acquired further knowledge about the properties of oils, and in particular, their classification into drying, semi- drying or non-drying, we can examine oiling instructions in a new light.

The "Plenty and Often" School

It now becomes obvious that if a writer recommends the use of semi-drying or non-drying oils such as almond, olive, peanut or coconut oil, a "plenty and often" application procedure should also be recommended. These oils will not polymerise into an impervious film. Rather, they remain on the surface of the wood as a thin film of liquid. With "swabbing out" of the recorder after playing, most of the oil will be removed, and it must therefore be replaced regularly. If such oils are used, therefore, they need to be used frequently - it is not intended that the oil become a permanent part of the recorder!

The "Little and Seldom" School

It also becomes obvious that if a writer recommends the use of a drying oil such as linseed oil, a "little and seldom" application procedure will also be recommended. The oil will adhere to the wood and polymerise into a tough, impervious film, becoming a permanent part of the instrument.

There is a good reason for allowing several months between applications if a drying oil is used. After the oil is spread over the surface of the wood, any excess is wiped off, leaving a very thin film. Exposure to the air will cause polymerisation to commence almost immediately and at normal temperatures (about 20ºC) it will be substantially complete in a couple of days. However, the final part of the polymerisation reaction will continue for several months after oiling. During this period, swabbing of the instrument may remove a little oil that may not have polymerised, but the only other effect will be to polish the polymer surface.

Which?

The choice of "school" is up to you. Both

approaches are valid. The important thing, how ever, is not to mix the two approaches. If you decide to use copious quantities of oil and to re-apply the oil frequently, you must select a non-drying or semi-drying oil. If not, you may be faced with a recorder filled up with a heavy layer of messy "gunk". On the other hand, if your choice is to oil sparingly and infrequently, you should select a drying oil. If you do not, the oil you apply will soon be removed and for long periods you r recorder will lack the protection it needs.

End- Grain

There are parts of the recorder that are especially susceptible to the effects of moisture, and which therefore will benefit from the protective effects of oil. In particular, we should give attention to those parts of the instrument where the end-grain of the wood comes into contact with water. End-grain is exposed when the wood is cut at right angles to the direction of the grain, and water can most easily penetrate the wood at such points. The principal places where this can occur are at the tenons and sockets, particularly the upper one where the headpiece connects with the barrel. Always ensure that these end-grain parts are oiled. In bass and larger recorders there is often a wind-cap, and here too, water can come into contact with the end-grain. Such points require oiling. It's difficult to generalise here, because of the wide range of windcap designs, but careful inspection will readily reveal the places where moisture and end-grain come into contact. End-grain is exposed at the ramp - the sloping surface from the bore to the exterior of the headpiece, just below the window. In the course of manufacture, several prestigious makers varnish and seal the wood of the ramp, without adverse consequences upon the tone, so it may be concluded that the sealing effect of oiling will do no damage. However, remember that the wood is very thin at the edge, and that damage could result from over-vigorous mechanical pressure either during application of the oil or rubbing it off.

How to oil a recorder

My own strong preference is for the use of a drying oil. The best drying oil is linseed oil, which is readily available at low cost. The following procedures are valid for the application of both drying and non-drying oils. However, if you are using a non-drying oil, you may ignore those parts of the instructions that involve waiting for the oil to dry, and any comments that obviously apply to drying oils only. Here are some of the things you'll need:

- a piece of cotton fabric. An old handkerchief is very suitable. It is thin, about the right size and not inclined to shed fibres.
- recorder swabs. These are usually shaped like a bottlebrush, with a twisted wire handle with a "head" of wool fibres. They are of ten supplied with new recorders, but are not much help in wiping out a recorder because they don't seem to absorb water very well, merely pushing it about from one place to another. However, if you wrap an oil-damp cloth around the head of one of these swabs, you'll be able to apply oil to places that are otherwise difficult to reach.
- another piece of fabric, for polishing. An old T-shirt is quite appropriate. Again pure cotton is best.
- soap and water, to wash the oil from the fabric and the swabs, so you can use them again at a later date. If you are using a drying oil, you should wash the fabrics and the swabs as soon as you have finished oiling. If you don't, the oil will dry in them, they will harden and you'll have to discard them.

The first step is to apply oil to the handkerchief. This should be done very gradually, and the fabric should be folded and squeezed after each addition of a little more oil, to ensure that the oil is evenly distributed throughout the fabric. Eventually you will reach a point where the whole of the fabric is oily, and the fabric has taken on a pale, even translucency. It should not be possible to squeeze liquid oil from the fabric. Application is simple: to wipe the outside of the instrument and the end-grain areas, use the oil-damp cloth as it is. To apply oil to the inside, wrap the fabric around the head of an appropriately sized swab and pass it carefully through the bore.

After oiling, there is no particular advantage to be gained by allowing the instrument to stand. Wipe the instrument, inside and out, with the clean polishing cloth. After this has been used, a very thin coating of oil remains. Because it is so thin, polymerisation of the oil will begin almost immediately. The instrument should be put aside and not played for two days.

The Foot Piece

The procedure here is to pass the oil-damp cloth through the bore, and then attend to the end- grain in the joint socket. The only problems in oiling the outside of the foot-piece arise if there are keys there. Irrespective of whether you are using a drying or a non-drying oil, you must keep it away from the keys and keypads. Both the key mechanism and its pad will be adversely affected by oil. The effectiveness of key pads and tenon wrappings depends on the achievement of an airtight seal, but the effect of a drying oil is to harden the leather, cork or thread so that it no longer remains flexible enough to mould itself to the shape of the tone hole or socket. Keep

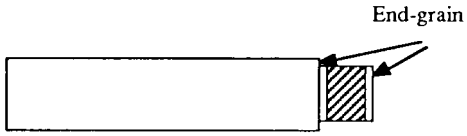
drying oils away from ivory fittings because, there is a slight tendency to yellowing due to the film of polymerised oil. Usually, one likes to keep ivory fittings as white as possible. Otherwise, the effect of oil upon ivory is neither beneficial nor adverse.

The Barrel

If it*s a small recorder, oil the bore by twisting the oil-damp cloth through it several times. If it's a large recorder, wrap the cloth around the head of an appropriately sized swab and push it into the bore from either end. You can check progress by squinting down the barrel to ensure that the oil coverage is even and complete. Don't be tempted to speed things up by adding oil to the fabric until it is saturated and wet, then slopping it into the bore. It is preferable to remain patient and achieve evenness of application through persistent application of a moderately damp rag. If there are keys on the barrel, give them a wide berth!

Should you oil the finger-holes? It is unnecessary to oil those on the top of the instrument because they don't come into contact with liquid water. However, the thumb-hole is exposed to liquid water. Moreover, it exposes end-grain, so it will benefit from oiling. The oil cloth can be twisted into a cylinder and poked into the thumb-hole to oil it.

At the tenons, attend to the end-grain. The tenons will be wrapped with thread or with cork. In either case, keep oil away from the wrapping.



The Head-Piece

We will deal with the head-piece section by section:

The block: It is not particularly important that the block be able to absorb water. Many recorders are constructed entirely of plastic material that is totally impervious to water, and they are no more susceptible than wooden recorders to the effects of liquid water in the windway or head-piece bore. It should be remembered that any water-absorbent properties of a wooden block are relevant only until the block has become wet, after which it cannot absorb any more water. What is more important is that water should not accumulate in the windway on the upper surface of the block. Rather, it is desirable that any water that forms in the windway will clear away by running down into the bore of the recorder. Well-designed windways tend to clear themselves during playing, but any oil in the windway inhibits this natural clearing ability. If oil finds its way accidentally into the windway, it can be removed with acetone, which has no adverse effect on wood (you may need to remove the block to do this). If you are using a drying oil, remove the oil quickly, before it polymerises to any significant extent. The sensible practice when oiling the head-piece is to oil the bore up to about one centimeter below the edge. If you can establish a technique that enables you to oil the lower part of the bore close to the block (i.e. opposite the window) without any possibility of damaging the edge, that will be an advantage because this part of the bore is exposed to much water. This task is made easier if the block is removed, but not everybody feels confident in doing this - I certainly don't!

The socket and the ramp have been discussed already under the heading '"End-grain". Wrap the oil-damp rag around a fine object such as a matchstick, and apply it with precision to the ramp where the ramp and the ramp "walls" meet. Oil up to the edge.

Finally, should you oil the "beak" of the recorder and its underside, including the back of the block? Again, one should note that several prestigious makers varnish these surfaces without apparent disadvantage to the tone production, so sealing the wood should have no adverse effect. However, do not allow oil to enter the windway!

- *Terry Simmons took his degree as a textile physicist at the University of NS W and has worked for many years in the Textile and Clothing industries; he now works at the Warrnambool campus of Deakin University. He has been a recorder player since 1962 and later studied singing with Catherine Senftleben. He has played and sung with several early music and theatrical ensembles in Victoria's Western District and is a frequent solo recorder recitalist with harpsichordist and jazz pianist Gavin Franklin. He also regularly broadcasts a music programme for community radio station 3 WAY-FM.*

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[1] Fatty acids are so named because of the need to observe strict conventions in the nomenclature of chemical compounds. In fact, they are very weak acids, and they have no chemically damaging effect on wood.

[2] Recorder Technique, OUP, 1959, p34.

[3] Bailey's Industrial Oil and Fat Products, Ed. Daniel Swern, Interscience Publishers, 1945.