FLUXES FOR CASTING ALLOYS

When you have melted enough bullet alloy to start casting what you want to make, the first step is to flux your melt so it is nice and shiny and clean looking.

When fluxing a melt make sure that the fumes are ventilated out of the work area by blowing them out a window with a fan, or doing it outside. There are lots of handy materials around that will make good fluxes and the most popular ones are old candle stubs and paraffin wax. There are other things that work well, such as sugar, lard, vegetable oil, Vaseline, baby oil, non-detergent motor oil, plastic sandwich baggies, sawdust, rosin, beeswax, and corn starch, just to name some that have been more or less used successfully. When these are added to melted bullet alloy, the fumes produced must be ignited to burn them off. As already mentioned, the smoke and vapors that are produced have to be ventilated out of the work area because they are rather noxious as well as poisonous since they contain lead and antimony fumes. Once the flames die out, the fumes and vapors diminish and it is safe to continue casting indoors as long as fresh air and ventilation are provided. During a casting session the bullet alloy should be refluxed when the gray powdery dross material builds up on top of the molten metal in the pot. Don’t throw this stuff away because it is part of the alloying ingredients of the bullet metal that have been oxidized. Apply a flux instead to conserve it.

WHAT FLUXES DO

The exact role that a flux plays in bullet casting is not very evident to the caster, but is a very important one nonetheless. At first glance the only apparent purpose for using a flux would seem to be to keep the alloy clean and shiny while molten. The actual purpose is to keep the composition of an alloy constant during the period of time that it is molten, although having a clean and shiny appearance is useful since it is a good indication that the flux is working properly. Fluxing keeps the physical characteristics of the bullets being produced uniform, and uniformity is one of several important criteria necessary for making bullets that will shoot accurately. Uniform physical characteristics are defined as having the same hardness and specific gravity, as well as a third characteristic not often mentioned or even known about, which is having uniform aging characteristics. Aging uniformly is an important characteristics because it is nice to know when a certain batch of bullets will reach its ultimate hardness so that they can be used without waiting unnecessarily, or to avoid using them prematurely. Hardness helps with preventing leading, and controls expansion on game to a certain degree as well. All of these important characteristics are in part controlled by the composition of the bullet alloy, so keeping the alloy composition constant is a key factor to successful bullet casting, especially when casting for accuracy.

HOW FLUXES DO IT

Bullet casting alloys are composed of mixtures of metallic and semi-metallic elements, usually lead, tin, and antimony. In general, an alloy’s usefulness depends on its physical characteristics, which in turn are dependent on its specific composition. Fluxes are used to help keep the composition from changing due to selective oxidation of its components while the alloy is molten. In general, fluxes have three modes of action to do this, which are returning constituents back to the alloy when they become separated by oxidation, preventing oxidation of the casting alloy by excluding air, and combining with contaminants so that they can be sequestered and removed. The fluxes most commonly used for preparing and casting bullet alloys perform only the first two functions to any great degree. Fortunately, having to deal with contaminants during normal casting operations is not a major problem since properly prepared casting alloys have already had any contaminants removed. Any incidental contamination that occurs during casting is usually very minor and such contaminants handily float on the surface where they can be easily skimmed off with a dipper if they present a problem. A word of warning at this point is necessary, though, since most material floating on top of the bullet metal is not contamination or dirt, and is instead very probably tin and antimony oxide. These should be treated with flux instead of being removed!

KINDS OF FLUXES
There are two main types of materials used for preparing and cleaning casting alloys that are both called fluxes, and there is usually some confusion about what they actually do and when they are needed. The first and most commonly used flux works by maintaining the composition of an alloy while in use. The second type of flux is used to clean and remove unwanted material from an alloy. These two functions are separate and distinct from one another, and except for one particular fluxing agent, are done by two very different kinds of materials. Fortunately, using the wrong material does not cause any damage beyond not getting the desired results.

The first and most useful agent for conditioning molten casting alloys is actually not a flux at all from a metallurgical/chemical standpoint and in reality is a smelting agent. However, through common usage of calling it a flux it has come to be regarded as such because it appears to do the same exact thing as a true flux. For bullet casting purposes there is no point in not calling the first type of agent a flux, though, since trying to make such a distinction would only cause more confusion. During casting operations, the most commonly used and beneficial type of fluxing agent is used to reduce, or smelt, valuable alloy constituents that have become separated from the melt by being oxidized by air while the alloy is molten. Once reduced from the oxide back into the elemental state, the constituents will dissolve back into the alloy. This kind of reducing agent is most often some kind of organic material such as paraffin, other candle waxes, sugar, beeswax, pine rosin, non-detergent engine oil, Vaseline, lard, vegetable oil, polyethylene (also called polythene in Europe, and is the plastic used for sandwich bags), sawdust, corn starch, etc. These agents work by chemically combining with the oxygen in the oxidized alloy constituents, thus returning them to their elemental state so that they may dissolve back into the alloy. Powdered charcoal is preferred at temperatures above red heat, but most bullet casters rarely ever need to get their casting metal that hot, and then only for making certain special alloys with high melting point ingredients. Because casting alloys usually contain very toxic ingredients, most notably lead and antimony, it is a good idea to heat them only as hot as is necessary to use them. However, it is important to note that despite the toxic nature of lead and antimony, at normal casting temperatures their safety has been repeatedly noted by many active casters and shooters who have had blood tests done specifically for these toxic elements. They have often reported that their blood levels for these were no different than that of the general population and sometimes actually below it!

The second type of agent is a true flux from a metallurgical and chemical standpoint. True fluxes work by chemically combining with contaminants to form new compounds that are very easily removed from an alloy. What makes true fluxes uniquely valuable is that they selectively combine with the unwanted materials, making them useful for purifying certain metals. Except for one, the true fluxes unfortunately have very little or no benefit for use in bullet casting alloys, and they are this way for three reasons. First, the most commonly used true fluxes are borax, boric acid, and potassium fluoborate, all of which only become active at or above red heat when they are molten. Potassium fluoborate, usually used for silver soldering, is quite poisonous when ingested and also causes very deep skin burns that are slow to heal. The very high temperature that they require to work keeps them from being useful for bullet alloys because at high temperatures the alloy will produce dangerous amounts of lead and antimony vapors. Besides that, the temperature is way too far above what is useful for casting and will actually destroy aluminum and brass moulds. The third reason is far more compelling, though, because when the alloying constituents used in most bullet alloys become oxidized, these fluxes totally remove them from the melt instead of returning them, which rapidly depletes them from the alloy. Since the first type of fluxes mentioned return the constituents back into the alloy, they serve a far more useful purpose than do the second type, and as such the first type is greatly preferred for bullet casting. Since the temperature range for bullet casting alloys is far below the point where borax will provide any fluxing action, the success with borax that has been occasionally reported by casters is due to it keeping air away from the molten metal surface, thus preventing oxidation. Cat litter and Portland cement powder do the same thing and are far cheaper.

The one lone standout in fluxing agents that actually works as both a reducing agent and true flux is pine rosin. It reduces the oxidized alloy constituents back into elemental form as well as dissolves contaminants so that they may be removed. Since large amounts of pine rosin are needed for casting, it may be too costly to use in relation to the benefits it provides. However, if a pine forest is nearby, the lumps of pitch that drip and collect under pine trees can be gathered and used for casting. Rosin should be ignited the same as other flammable materials that are used for alloy fluxing, and its heavy, black, sooty smoke avoided just as well. There is nothing about pine rosin that is so remarkable that it should be highly sought after, just use it if it is cheap or free.
Casting alloys come from several sources and the common ones are reclaimed wheel balancing weights used for automobile tires, reclaimed bullets (also called range metal or range scrap), old sewer pipes and sewer pipe joint seals, telephone cable sheath, discarded hospital x-ray shielding, sailboat keels, and some kinds of roofing. These sources of lead scrap are usually contaminated with dirt, paint, glue, asphalt, plastic, and various other metals. These contaminants all have to be removed before a usable product is obtained that is ready for bullet casting. The best way to clean up scrap metal is to melt it down outside where the smoke from it won’t cause trouble and use the cheapest non-detergent straight viscosity weight engine oil available as a fluxing agent. Ignite the oil so that the fumes from the rubber valve stems, plastic, paint, glue, and other flammable debris that is invariably contained in scrap lead all get burned up. When the flammable stuff seems to be all burned up, keep turning and stirring the lead to keep releasing more of theflammables that are held in the floating debris on top of the lead. After the molten lead stops smoking and burning, then add a bit more non-detergent motor oil to it and re-ignite it. Stir it in until it goes out again, then skim the floating dross off the top until nothing but shiny metal is left in your melter. Cast it into an old discarded muffin pan to make ingots to use later. When cool, wrap up the debris skimmed off the top in newspaper and discard it where it will be taken to a landfill. That stuff is loaded with lead and antimony oxide and probably contains cadmium and arsenic as well, so make sure that it goes to a landfill instead of going into the soil or water.

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