

Collecting and Shooting the Military Surplus Rifle



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Tennessee Gun



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Imagine, (or perhaps you already did this), you go to the rifle range for a relaxing 200-300 rounds of shooting your Mosin-Nagant 91/30 rifle. You are using the corrosive, but cheap Albanian ammo and just popping holes into paper. Suddenly, you remember that you forgot your wife's birthday, so you toss your rifle (unloaded) into your vehicle and hightail it back home. When you get home, you put the rifle aside in the garage or basement, vowing that you will be back shortly to clean it. Yeah right...three days later you remember. Dread sets in. You look down the barrel of the rifle and you see...rust.

This probably has happened to nearly all shooters at one time or another. Perhaps not the part about missing your wife's birthday, but probably the part about finding rust

formation in a favorite rifle. Maybe you swear that the sales guy said that the ammo was non corrosive. Or, perhaps, you cleaned it with your favorite gun solvent, and still it rusted. What is the deal?

In this first article, I obtained 23 commercially available gun cleaning solvents. Some of these are popular, some are new, some have been around for ages (literally). Working with a select few "science" shooting guys, I formed what we like to call a sort of "mythbusters" type group. The goal was to see which solvents removed salt off of metal the best, given as stringently as possible similar conditions.

Before I get into the explanation of the experiment, lets talk a bit about what rust is, how it forms and where it comes from in terms of firing corrosive ammo.

What is rust?

Rust is the substance formed when iron compounds corrode in the presence of oxygen and water. It is a mixture of iron oxides and hydroxides. Rusting is a common term for corrosion, and usually corrosion of steel.

How does rust form?

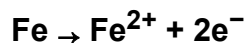
Rust formation is an oxidation reaction where iron metal wants to return to a more favorable or stable state. In order for rust to form, three things need to be present, iron, water and oxygen.

There are three basic stages of rust formation.

1. The formation of iron (II) ions from the metal
2. The formation of hydroxide ions
3. The reaction of the ions with the addition of oxygen to form rust

Viewed chemically:

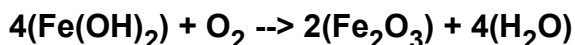
1. When water contacts steel it starts an electrochemical process there iron is oxidized to iron (II).



2. The electrons released (seen as 2e^{-} above) interact with dissolved oxygen in the water and reduce the oxygen and water to form hydroxide ions.



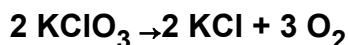
3. The hydroxide ions (seen as 4OH^- above) react with the iron (II) ions (Fe^{2+} from the first reaction) to form iron oxide, seen below as $\text{Fe}(\text{OH})_2$. In the last step of the process, the iron II reacts with oxygen and forms iron III (Fe_2O_3) which is commonly called rust.



Some things to remember. The process is faster in seawater than fresh water because of the salt ions present which makes the water more conductive. Enough of the chemistry, how does it relate to our favorite pastime?

Shooting Corrosive Ammo

What is the deal about corrosive ammo? It is actually a very basic and simple concept. The problem stems from the compound used in the primer of the ammunition. Corrosive ammo has potassium chlorate in the primer. Potassium chlorate (KClO_3) is a very strong oxidizer, that is, it is used to make a fuel burn. When the KClO_3 is heated, it releases oxygen which then causes increased combustion of the primer fuel (typically made of either barium nitrate, lead styphnate or antimony sulphide). Think of the primer as a spark plug that ignites the main powder charge through either the 2 or 3 holes of a Berdan shell or one hole of a Boxer shell. Basically, the KClO_3 converts following this equation:



During the combustion of the fuel of the primer, the oxygen (O_2) is used up. This leaves behind the KCl, potassium chloride salt, a cousin of common table salt, sodium chloride.

By itself, KCl does little harm to metal. The problem is that KCl is hydrophilic, that is, it LIKES water and draws water to it. (By the way, KCl is used in lethal injection executions because, given in massive doses, it causes cardiac arrest and death). We have seen above in our little chemistry lecture that salt can speed the rust formation process.

The bottom line is this, the potassium chloride (KCl) makes plain water a better electrolyte to help chemical equation #1 above quicker. In order to preserve your gun metal, you need to do two things, remove salt and remove/protect the metal from water.

The Experiment

Probably the best way to test whether a certain solvent works against the KCl (hence forth known simply as salt), would be to take a rifle, fire known corrosively primed ammo through it, clean with the solvent and watch and wait. And repeat the process. This would

work if you had a LOT of ammo and time on your hand. And even so, who is to say that you did not get EVERY last grain of salt out of the barrel before testing the next solvent? Needless to say, that is not the way this experiment was run.

Instead of using a gun barrel and endless amounts of ammo, mild angle iron was used as a metal base. The sections of angle iron were cut into 18 inch lengths to that they would fit into my [easy bake oven](#). Some initial tests showed that something had to be done to separate each test area on the angle iron, so I cut 2 inch sections on one side of the angle iron. This way there was a physical gap between test sections. The metal was first cleaned using a 3M abrasive disk in a drill that removed any initial corrosion or scale on the metal. The metal was also wiped down with acetone to completely degrease it. A solution of potassium chloride was made up in de-ionized water at a concentration of 180mg/ml. Five drops from a dropper were used which delivered roughly 500ul of the solution, so about 90mg of salt was deposited onto the metal.

Initial tests were run on how to put the salt onto the metal. The problem with putting the salt onto the metal and leaving it as a liquid was that rust was observed to form in approximately 15 minutes. A test was run where the salt water was added to the metal and then the metal was heated in the easy bake oven, however this also yielded rust formation in a matter of minutes. A final method was developed where the test section of metal was heated for approximately 20 seconds with a propane torch and then 5 drops of salt solution was "sizzled" onto the metal, which yielded very uniform results and no immediate rust formation.



Metal test area was heated with propane torch for approximately 20 seconds. Bricks were placed on either side to control splattering.

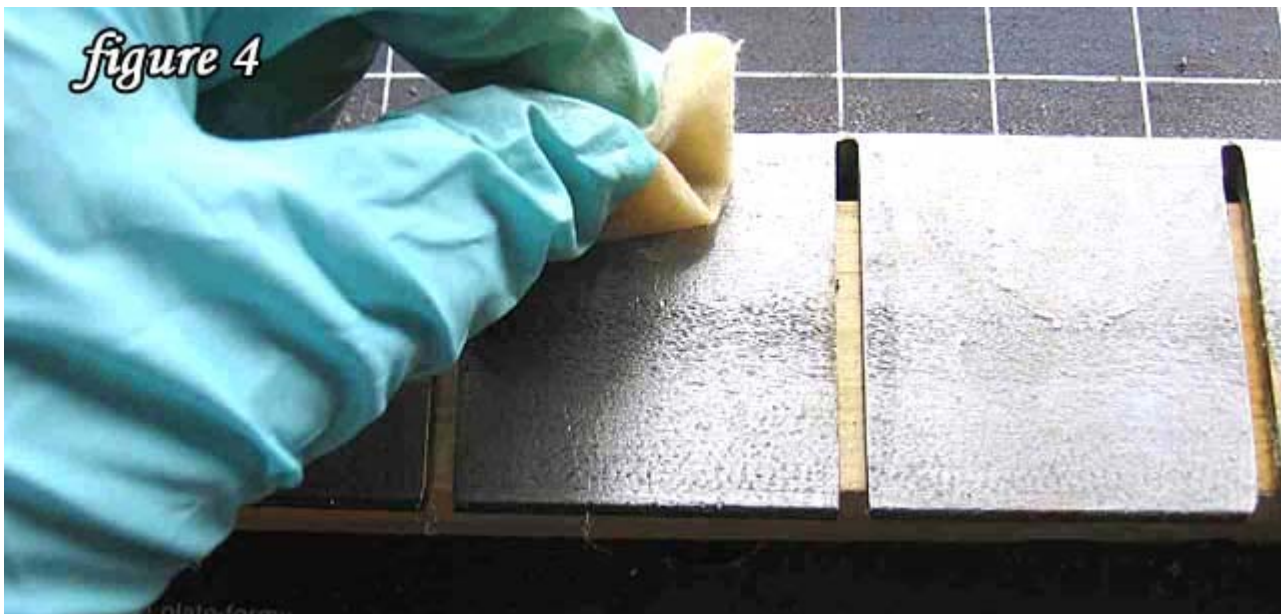


Salt solution was added drop wise. Heat was enough to sizzle it to dryness immediately.

The premise was to place the salt onto the metal and clean the salt off using the solvent on a saturated patch. Each solvent would get an equal number of swipes with the saturated patch. In addition, an untreated (no salt) section of metal would be swiped by a saturated patch to act as a control, that is to see what, if any, effect the solvent had on the bare metal.



Using a saturated patch, I wiped down the salt encrusted area several times until no salt was evident. For Rep 1, 10 passes were made, back and forth. Rep 2 had 15 passes per solvent.



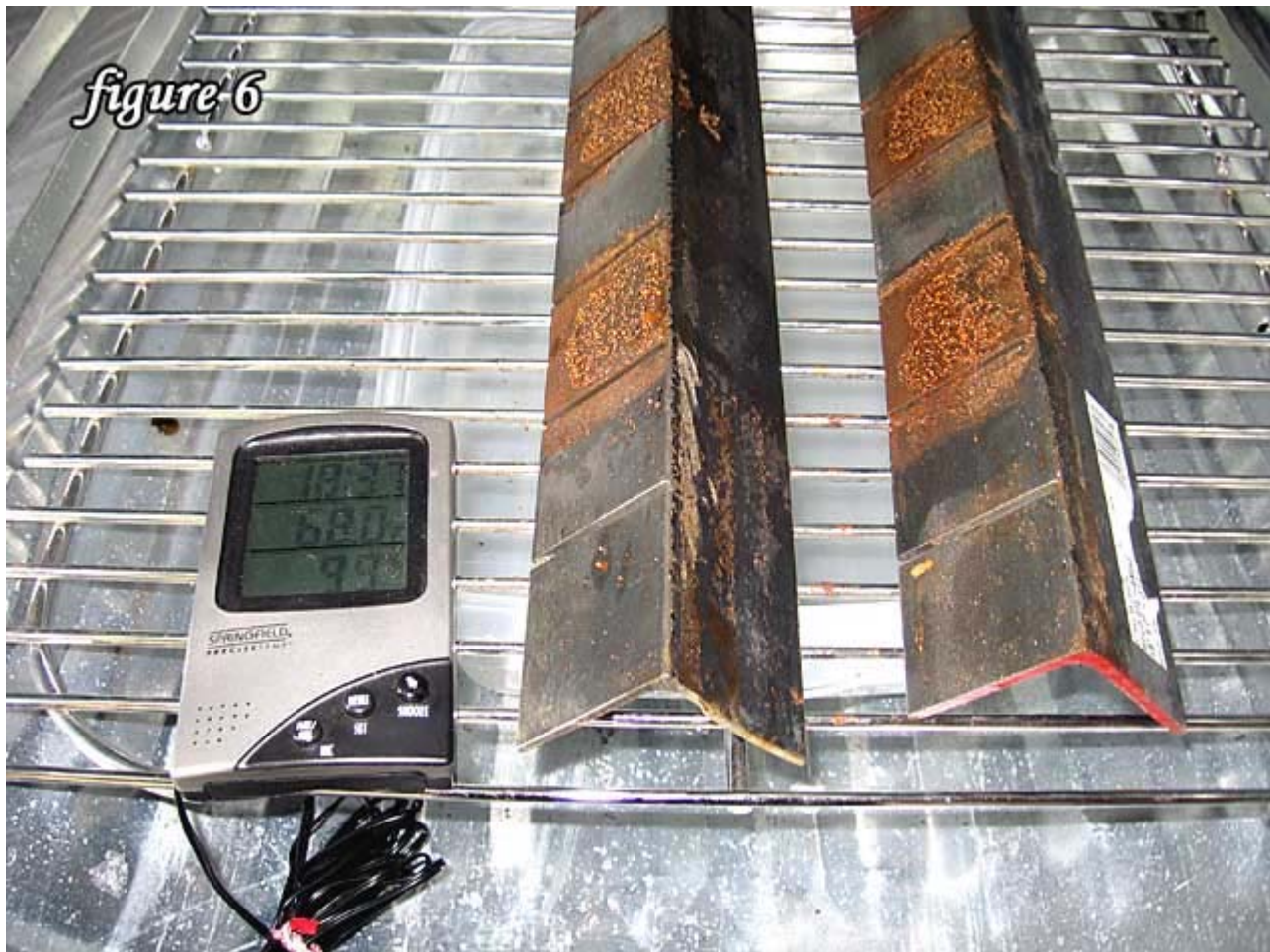
Wiped down an adjacent section (new patch) with just solvent, no salt as a control. In both cases a quick light wipe with paper towel to dry things off. Note the section on right is a salt treated but not yet cleaned test section.

The testing process was repeated once, randomly mixing up the solvent locations on the metal test areas each time. The metal test areas were cleaned before reused by washing in hot soap water, treating the metal test areas with rust removing jelly, rinsing it completely with hot water and then cleaning the metal again using the afore mentioned 3M abrasive disk.

A small test run was made using just Hoppe's No 9 solvent (it was what I had on hand). Initially, I did the swipes as stated above and placed the metal into the oven with a pan of water under it and the lights on for a temperature of about 100F. And I waited..and waited...and waited. No rust formed. My digital thermometer and hygrometer (measures humidity) gave temps of about 100F and humidity of about 20%. I had thought that the pan of water inside the oven would increase the humidity substantially, however that was not the case. (this fact came in handy for another test later) Dejected, I turned the oven off. The next day I was going to repeat the test. Upon opening the oven I saw nothing but rust all over the treated metal. And the humidity was at 99%. So the protocol was to place the treated metal into the oven with a pan of water and allow to heat roughly 175F for about 30 minutes and then shut the lights (heat) off. Apparently, the heat from the bulbs was enough to keep the humidity in check, heat the metal and keep rust from forming.



Placed in heated oven with water bath at bottom (not in picture) for about 30 min (sealed, heat about 175F). Then turned lights off. Kept lid on tight. Humidity went to 99% and I left them in there for 18 hours.



Here you can see some test strips and the digital thermometer and hygrometer. Note the temperature is 68F and the humidity is 99%.

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