This invention relates to the removal of harmful deposits from oil burning furnaces and the periodic preparation of oil burning furnaces for continuous trouble-free operation.

Many homes and buildings are heated by furnaces which operate automatically on distillate petroleum oil to maintain a pre-set room temperature and to supply domestic hot water. The furnaces and burning equipment become coated with soot and carbonaceous deposits of various kinds during operation which results in the impairment of the heating efficiency. The deposits may build up to such a level, if not attended to, so as to cause a breakdown of the equipment and hence a periodic cleaning of the burner and various related parts of the furnace is recommended.

The customary procedure followed involves the disassembly of the burner mechanism and furnace or boiler parts to expose the clogged and sooted parts to mechanical cleaning. The deposits are scraped, rubbed and abraded from the surfaces and the furnace and burner parts are reassembled. In home furnaces generally this is done annually and this cleaning is intended to last for the entire heating season. In many instances, however, it has been found necessary to service the burner during the season in order to continue the burner in operation. Service calls have been too frequent and hence an improved cleaning technique has been sought.

With the usual mechanical cleaning as parts are disassembled and assembled, dirt is dislodged in the system but not removed. When the burner is reassembled, the loosened dirt subsequently flows through the system and may plug the system one day, two weeks or a month after cleaning requiring immediate burner service. Additionally, the making and breaking of many connections makes possible the improper connection or reseating of these parts which may subsequently cause leaks requiring burner service.

Furthermore, the disassembly of the burner is time consuming. With labor costs rising steadily each year this time consuming operation is becoming increasingly expensive. An alternate cleaning scheme has been sought that would be more reliable as well as more economical. The improved cleaning technique to be satisfactory must simultaneously clean the burner parts and remove soot from heat transfer surfaces since the soot reduces heat transfer rates and makes the furnace inefficient and may even render the system inoperative. The development of a composition for accomplishing all the required cleaning in an oil burning furnace in a single operation has, until this time, posed an insurmountable problem.

In the past, various additives have been added to the fuel oil to keep the burner clean or to remove soot from the heat exchanger surfaces. These addition agents have unfortunately not been successful and furthermore have added to the cost of the fuel. In some instances it has been found that these addition agents may have been detrimental and may have, in fact, added to burner and furnace difficulties.

We have discovered a formulation which can be passed through the burner in place of the fuel during a clean-up period and burned in the furnace to clean-up carbonaceous deposits and remove soot simultaneously with-out requiring mechanical disassembly of the parts. The cleaning is quick, economical and effective. Our improved formulation is critical and comprises broadly:

1. 40-90% by volume of a distillate petroleum oil of 75 to 100% aromatics content.
2. 3-25% by volume of the lactate salt of 2 heptadecyl imidazoline.
3. 5-20% by volume of a butyl alcohol.
4. 2-25% by volume of a selected metal naphthenate.

Many variations of the above indicated formula have been tried but surprisingly even slight variation results in inferior cleaning and the formulation is noticeably less effective. The preferred formulation is as follows:

1. 50-80% by volume of a distillate petroleum oil of 75% to 100% aromatics content.
2. 5-20% by volume of the lactate salt of 2 heptadecyl imidazoline.
3. 10-15% by volume of a butyl alcohol.
4. 5-20% by volume of a selected metal naphthenate.

The object of this invention is to provide a method and product for cleaning oil heating furnaces which overcomes the objections of prior cleaning techniques. A further object of this invention is to provide a method and product for cleaning oil burning furnaces that is faster, more economical and more efficient than prior cleaning procedures. A further object of this invention is to provide a chemical cleaning composition for oil heating furnaces that permits cleaning of burner parts and furnace parts without disassembly. A further object of this invention is to provide a cleaning solution that will dissolve deposits from burner parts and remove soot from furnace surfaces in oil heating furnaces during short cleaning periods without requiring disassembly of the burner or furnace.

These and other objects of the invention will be made more apparent in the following detailed discussion of the invention.

The first ingredient of our formulation comprises a highly aromatic distillate oil containing about 75-100% aromatics and boiling within the range of 300-700° F. There are many sources for the aromatic oil of this invention, such as fractions from recycle bottoms from catalytic cracking, bottoms of catalytic reforming, aromatic-rich bottoms from the production of ethylene and propylene at high temperature, Edeleneu extracts, aromatic coal tar fractions, aromatic fractions from the hydrogenation of coal or the hydrogenation of coker gas oil.

<table>
<thead>
<tr>
<th>TABLE I Properties of aromatic oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity, A.P.I.</td>
</tr>
<tr>
<td>Flash, PM, * F.</td>
</tr>
<tr>
<td>Flash, COC. * F.</td>
</tr>
<tr>
<td>Vis. SUS @ 100° F.</td>
</tr>
<tr>
<td>Color, ASTM</td>
</tr>
<tr>
<td>Color</td>
</tr>
<tr>
<td>Unsulfonated residue, percent</td>
</tr>
<tr>
<td>Pour point, * F.</td>
</tr>
<tr>
<td>Percent aromatics</td>
</tr>
<tr>
<td>Mixed aniline</td>
</tr>
<tr>
<td>Cloud pt., * F.</td>
</tr>
<tr>
<td>Distillation: I.B.P., * F.</td>
</tr>
<tr>
<td>50%, * F.</td>
</tr>
<tr>
<td>Final, * F.</td>
</tr>
</tbody>
</table>

The second compound of our formulation is also critical, being the lactate salt of 2 heptadecyl imidazoline.
This salt appears to provide unusual cleaning ability in this environment. The salt appears to combine with the highly aromatic oil, butyl alcohol and metal naphthenate to provide unusual and rapid removal of carbonaceous burner deposits, soot and other furnace deposits. Without the butyl alcohol and metal naphthenate or without the specified oil, the cleaning results, if any, are far less spectacular. There appears to be a synergistic action of these compounds whereby the cleaning of the furnace parts is effected to a high degree both of deposits of a firm nature as well as soot and other clinging deposits. The imidazole salt structure is as follows:

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{N} & \quad \text{C} \\
\text{C}_{6}\text{H}_{4}\text{N} & \quad \text{C}_{12}\text{H}_{25}\text{O} \\
\text{N} & \quad \text{H} \\
\text{H} & 
\end{align*}
\]

It has surprisingly been found that a small portion of a butyl alcohol must be mixed in this formulation and that other alcohols will not operate satisfactorily. Any butyl alcohol functions satisfactorily, normal, iso, secondary, or tertiary butyl alcohols being equally effective. Broadly the alcohol should be about 5-20% by volume of the formulation, the preferred range being about 10-15% by volume.

The final material in this formulation is either a lead, manganese or copper naphthenate. These compounds work effectively with the other ingredients in the removal of carbonaceous deposits and the removal of soot from the furnace surfaces, particularly the heat exchanger surfaces.

The liquid formulation is compounded from the ingredients disclosed above in the prescribed proportions. A measured quantity of the cleaning composition is fed into the burner in place of the fuel oil. For example, from one to two pints of the composition can be introduced from a suitable canister directly to the suction side of the fuel pump or, if the system is equipped with a filter, directly into the filter housing. The formulation is passed through the burner and burns in the furnace without difficulty. About 1-2 pints of the composition is generally adequate to clean the burner and remove the soot and deposits from the average home heating system. A somewhat larger charge may be used in the larger heating systems used in factories and large buildings.

**Example I**

A composition of the following materials was prepared:

58% by volume Cetrex 47
20% by volume Alusperse 100
15% by volume n-butyl alcohol
7% by volume of kaolin naphthenate solution containing
24% by weight of lead.

This solution was tried in a high pressure gun-type burner previously fueled with No. 2 fuel oil. The burner was used to fire a cast iron steam boiler at a rate of 1.2 g.p.h. The fuel system parts and the boiler fluxes were examined before treatment and the following deposits noted:

- **Pump strainer**—75-100% covered with \( \frac{1}{4} " \) sludge.
- **Nozzle strainer**—75-100% covered with \( \frac{3}{4} " \) sludge.
- **Nozzle swirl chamber**—Moderately dirty with sludge.
- **Boiler fluxes**—completely covered with \( \frac{3}{8} " \) to \( \frac{3}{4} " \) of soot.

The system was supplied with 1 pint of the test formulation and the parts were re-examined, the results being as follows:

- **Pump strainer**—5% covered with less than \( \frac{1}{8} " \) sludge.
- **Nozzle strainer**—clean.
- **Nozzle swirl chamber**—clean.
- **Boiler fluxes**—soot almost completely removed; this was also indicated by a decrease in flue gas temperature from 720° F. to 600° F.

**Example II**

The cleaning method of this invention was extensively field tested in a cold region in approximately 600 home heating units which had previously been cleaned by mechanical cleaning and scraping methods. The results showed that the service calls were sharply reduced from 110 to 3, indicating the improved results to be expected from this new cleaning technique.

The invention has been amply illustrated in the examples given above. The examples are presented only for that purpose and not to serve as limitations of the invention, the only limitations intended being found in the attached claims.

We claim:

1. A liquid composition for use in removing deposits from oil burning furnaces and the burners of said furnaces comprising:

   (1) 40-90% by volume of a distillate hydrocarbon oil of 75-100% aromatics content and boiling within the range of about 300-700° F.,

   (2) 2-25% by volume of the lactate salt of 2-heptadecyl imidazole,

   (3) 5-20% by volume of a material selected from the group consisting of normal butyl alcohol, iso butyl alcohol, secondary butyl alcohol and tertiary butyl alcohol, and

   (4) 2-25% by volume of a material selected from the group consisting of lead naphthenate, manganese naphthenate and copper naphthenate.

2. A liquid composition for use in removing deposits from oil burning furnaces and the burners of said furnaces comprising:

   (1) 50-80% by volume of a distillate hydrocarbon oil of 75-100% aromatics content and boiling within the range of about 330-560° F.,

   (2) 5-20% by volume of the lactate salt of 2-heptadecyl imidazole,

   (3) 10-15% by volume of a material selected from the group consisting of normal butyl alcohol, iso butyl alcohol, secondary butyl alcohol and tertiary butyl alcohol, and

   (4) 5-20% by volume of a material selected from the group consisting of lead naphthenate, manganese naphthenate and copper naphthenate.

3. A liquid composition for use in removing deposits from oil burning furnaces and the burners of said furnaces comprising:

   (1) 50-80% by volume of a distillate hydrocarbon oil of 75-100% aromatics content and boiling within the range of about 330-560° F.,

   (2) 5-20% by volume of the lactate salt of 2-heptadecyl imidazole,

   (3) 10-15% by volume of normal butyl alcohol, and

   (4) 5-20% by volume of lead naphthenate.

4. A liquid composition for use in removing deposits from oil burning furnaces and the burners of said furnaces comprising:

   (1) 50-80% by volume of a distillate hydrocarbon oil of 75-100% aromatics content and boiling within the range of about 330-560° F.,

   (2) 5-20% by volume of the lactate salt of 2-heptadecyl imidazole,

   (3) 10-15% by volume of normal butyl alcohol, and

   (4) 5-20% by volume of manganese naphthenate.

5. A liquid composition for use in removing deposits from oil burning furnaces and the burners of said furnaces comprising:

   (1) 50-80% by volume of a distillate hydrocarbon oil of 75-100% aromatics content and boiling within the range of about 330-560° F.,

   (2) 5-20% by volume of the lactate salt of 2-heptadecyl imidazole,
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(3) 10–15% by volume of normal butyl alcohol, and
(4) 5–20% by volume of copper naphthenate.

6. The method of cleaning oil burning furnaces and
the burners of said furnaces consisting essentially of
supplying directly to the burners of said furnaces from
about 1 to 2 pints of the cleaning composition of claim 1
in place of the usual burner oil and burning the cleaning
composition until the entire supply is consumed.

7. The method of cleaning oil burning furnaces and
the burners of said furnaces consisting essentially of
supplying directly to the burners of said furnaces from
about 1 to 2 pints of the cleaning composition of claim
2 in place of the usual burner oil and burning the cleaning
composition until the entire supply is consumed.

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