The Effect Of High Oil Viscosity On Oil Burner Performance

Uncategorized 664832, Fuel & Supply Systems

Oil viscosity can be simply defined as the measure of the oil's resistance to flow. No doubt most of us have seen what happens to syrup or molasses on a cold morning. In order to get the cold mass to flow easily, we had to add some heat. Actually, what we were experiencing was a change in viscosity.

Cold Oil

Cold oil can have a significant impact. The viscosity (resistance to flow) of fuel oil increases as its temperature decreases. The higher the viscosity, SSU number, the more resistant to flow the oil is.

The viscosity of typical No. 2 fuel oil increases from 35 SSU at 100°F to 52 SSU at 30°F. (See Figure 1.) An increase in viscosity of this magnitude will increase nozzle flow rate at 100 psi by 10% and increase the oil droplet size. (See Figure 2.) Let's look at some of the effects.

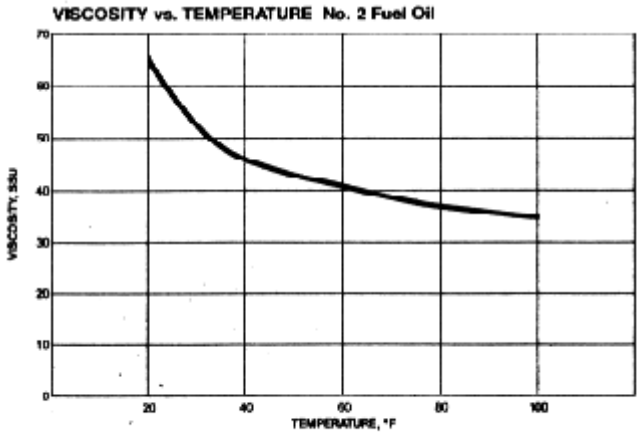


Figure 1

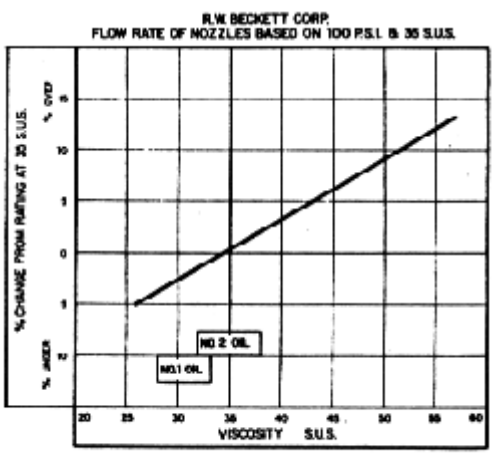


Figure 2

As the viscosity goes up, so does the flow rate through the nozzle. Initially, you may think the reverse would be true. But, if you take a moment to review how a nozzle works, you'll see why this is so.

Energy breaks up the oil into droplets. The energy is supplied by the fuel unit delivering oil to the nozzle under pressure. The nozzle, through the swirl slots, swirl chamber and orifice converts the energy from pressure to velocity

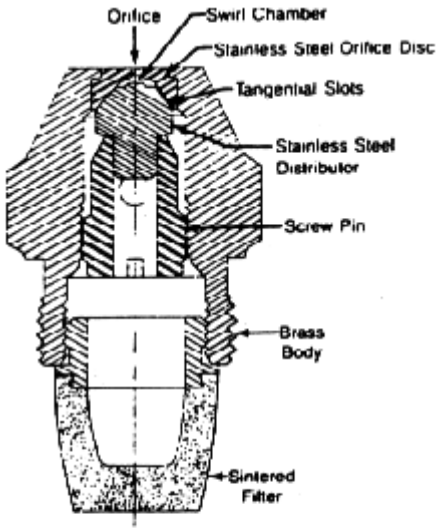
However, as the thicker oil enters the nozzle slots and swirl chamber, its rotational velocity is reduced. This causes a cone of oil to emerge from the orifice that has a much heavier wall thickness that produces a higher flow rate and larger droplets.

These larger droplets may not vaporize and ignite, or they may take longer to do so because they spray angle becomes narrower and moves further away from the ignition spark. The most common symptoms are:

Delayed ignition with "puff-backs" or no ignition at all.
A noisy flame that pulsates and becomes unstable. This can lead to appliance soot-up.

Another matter to consider is the maximum input rating of an appliance. Some appliances are designed to operate near maximum capacity. A major increase in the input could result in "over-firing" the appliance. This may lead to excessive heat upon the burner, or a smoky combustion process.

Taking Practical Measures



Cutaway view of a Delavan nozzle.

Figure 3

EFFECTS OF PRESSURE ON NOZZLE FLOW RATE

NOZZLE RATING AT 100 PSI	NOZZLE FLOW RATES IN GALLONS PER HOUR (Approx.)					
	80 PSI	120 PSI	140 PSI	160 PSI	200 PSI	300 PSI
.50	0.45	0.55	0.59	0.63	0.70	0.86
.65	0.58	0.71	0.77	0.82	0.92	1.12
.75	0.67	0.82	0.89	0.95	1.05	1.30
.85	0.76	0.93	1.00	1.08	1.20	1.47
.90	0.81	0.99	1.07	1.14	1.27	1.56
1.00	0.89	1.10	1.18	1.27	1.41	1.73
1.10	0.99	1.21	1.30	1.39	1.55	1.90
1.20	1.07	1.31	1.41	1.51	1.70	2.08
1.25	1.12	1.37	1.48	1.58	1.76	2.16
1.35	1.21	1.48	1.60	1.71	1.91	2.34
1.50	1.34	1.64	1.78	1.90	2.12	2.60
1.65	1.48	1.81	1.95	2.09	2.33	2.86
1.75	1.57	1.92	2.07	2.22	2.48	3.03
2.00	1.79	2.19	2.37	2.53	2.82	3.48
2.25	2.01	2.47	2.66	2.85	3.18	3.90
2.50	2.24	2.74	2.96	3.16	3.54	4.33
2.75	2.44	3.00	3.24	3.48	3.90	4.75
3.00	2.69	3.29	3.55	3.80	4.25	5.20
3.25	2.90	3.56	3.83	4.10	4.60	5.63
3.50	3.10	3.82	4.13	4.42	4.95	6.06
4.00	3.55	4.37	4.70	5.05	5.65	6.92
4.50	4.00	4.92	5.30	5.70	6.35	7.80
5.00	4.45	5.46	5.90	6.30	7.05	8.65
5.50	4.90	6.00	6.50	6.95	7.75	9.52

Figure 4

If the problem is cold oil, see if the above-ground tank can be moved inside or buried below the ground frost line and the supply lines insulated. Also, a one-pipe system is preferred over a two-pipe set-up where a choice is possible. The two-pipe system will circulate the rated capacity of the fuel unit gear-set, which could be 22 GPH. The one-pipe set-up draws ONLY the firing rate of the nozzle. This allows the oil to warm to the surrounding ambient temperature as it is drawn toward the nozzle. Some servicemen say heat tape gets good results. But, make sure you have the approval of your local building and electrical codes.

Next, allow the burner to operate for 10-15 minutes before making final adjustments. When the burner initially starts, the colder oil will increase the flow rate and smoke level. As the oil handling system warms, the combustion improves and overall operation stabilizes. Finally, ALWAYS USE TEST INSTRUMENTS WHEN MAKING BURNER ADJUSTMENTS.

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