

The Whiteness of the Whale – The Environmentalist’s Pursuit of Moby Dick, the White Roof in a Sea of Dark Asphalt Shingle Roofs

Misconceptions abound. They do among the so-called professionals, even. Let me start my white-roof story by telling you about a recent visit of a contractor to my home. He had blown in fiberglass insulation into my attic before I decided to paint my roof white. I had called him back because I had concerns that he hadn’t installed enough for what I paid him. I had asked him to bring it up to R49. In some areas it is less than that and I feel cheated.

Anyway, after his inspection of the attic, he descends down the ladder and back into my garage. It is a sunny 90 deg. F day in Sherman, TX. He turns to me and remarks: “This attic is quite cool. The radiant barrier that you installed really works.”

Now, the “radiant barrier” that he talks about is what I consider a failed experiment. Failed and expensive in fact. I bought two or three rolls of bubble-wrapped radiant foil at Lowe’s and installed (i.e. stapled) it under the rafters in my attic to cover portions of the south side of my roof. I had perhaps covered 15% of the total attic roof surface. The barrier did nothing for me. It couldn’t as I don’t have a ridge vent and there is no way for the heat to escape other than the openings for my two old burnt-out turtle-style attic fans. Prior to painting my roof, during a sunny day my attic would get up to 150 deg. F. On the day the contractor went up there, it was around 90 deg. F, just like the ambient outside air. He had probably never been in an attic that cool. He must have seen the striking whiteness of my roof when he pulled up. It is quite visible, even from farther away from the house. Brilliant and shiny. But it didn’t dawn on him that the coolness of my attic might have something to do with the white color.

Can we blame him for his ignorance? I suppose not because where I live people rely on the traditional asphalt shingles. The good old ways. That’s the way it’s been done in the past, that’s what will be used in the future. This makes no sense in Texas, though. I measured my own asphalt shingle roof on a sunny day and it read 170 deg. F. Not only is this an oven, it is really bad for the shingles themselves. How could it not? Every day, the cycle going from 75 deg. (night) to 170 deg. F (day).

Let me return to my encounter with the contractor just for a moment. Picture this: All my ductwork is in the attic. It’s new R6 flex for the most part. Not bad, but it still got infiltrated by heat when it was 150 deg. F in my attic. It plainly sucks to have ductwork, the air handler/furnace and the coil in the uninsulated hot attic. But that’s how it is here in Texas. Mr. Contractor wants to educate me on my cool attic after I explain to him that it is the white paint that keeps it cool. Says he: “It’s nice to have a cool attic but I don’t care much about attic heat. It doesn’t matter because the blow-in insulation keeps the heat out of the house.”

Now, I have heard that before. Sure, insulation retards the movement of heat down into your living quarters but it doesn’t stop it. It just delays it. Plus, a hot attic makes the ductwork very, very inefficient. Mr. Contractor is wrong about my house. And even though he doesn’t, I do care about attic temperature, even with insulation.

What Mr. Contractor doesn't know is that I save approx. 10kWh each day in the sunny summer of Texas. Yes, this is verifiable! My savings after blowing in additional insulation were noticeable, sure. However, they were much, much smaller (perhaps to the tune of an estimated 3-4kWh per summer day on average).

On to the meat of my story:

My house is a late 1960s one-story traditional brick ranch with an asphalt shingle roof, previously medium-dark gray, now white. The house is approx. 2600 sqf which includes the 400 sqf garage on the west side. It has old-style mineral wool insulation in the outside walls and used to have, inconsistently so, an R19 mineral wool insulation in the attic. Now it has, as I said earlier, a R30 to R49 insulation in the attic. The windows are all old-style single-pane aluminum frame with storm windows. Nothing you would consider efficient by any stretch of the imagination.

When we bought the house in 2012, we put in a 19 SEER high efficiency air conditioner when the old unit gave up the ghost. We like to keep it moderately cool, between 76 and 77 deg. F. The new unit helped A LOT (as opposed to the 20 some year old SEER 8-10 unit that we had previously)! Average consumption on a 100+ deg. F day was now 40ish kWh, roughly half of what we used before. After adding insulation it maxed out at 35ish kWh on a hot day.

Ever since I heard about white roof coating, I was curious to explore it. It made sense to me. However, it is prohibitively costly. To cover my approx. 3000+ sqf hip roof with two coats, I would have had to spend approx. \$1600 of the high-quality elastomeric coating just for the material (20 of those 5 gallon buckets or perhaps even more). I simply don't have the money for that right now. Plus, I have heard a few horror stories of moisture trapped with these coats. They might be true or not. I do not know. At any rate, even if the elastomeric coating lasts 10 years as the warranty claims (which I am somewhat doubtful for asphalt shingles), the payback will be minimal to nonexistent depending on your house and roof size. Especially if you have this job done by a contractor, it will, more or less, be a comfort decision only and not so much about savings.

Frustrated by the high prices of the elastomeric coating, I googled the topic extensively and found David Mundy's story on builditsolar! Hydrated lime! How simple and affordable. Two weeks of agony followed! Should I? Should I not? Will it make my roof ugly? Will it damage the shingles? Will it wash off right away?

Eventually, I threw caution to the wind and applied it all over my roof! Three days of frenzied toiling, a one-man show! Cars slowing down in front of the house, people watching, probably wondering what is going on. And, by Jove, it has done wonders! I can keep my 2200 sqf. of living space at 77 or 76 deg. in 100 deg. hot weather for less than \$2 a day! Yes, it really works. So far, by mid-July I have maxed out at 22kWh a day. And that includes our entire household of three people, one big espresso maker, one fridge, occasional stovetop use, frequent microwave use, 9 permanently installed AC operated smoke detectors (which consume 70 watts 24/7, believe it or not) and lights. We went all LED last year which

has helped with the lighting part. We haven't used the oven in the kitchen much but when we use it, of course, the consumption goes up considerably. We avoid using the dryer during the summer months, too.

When the ambient air temp is high, the white-roof attic, naturally, will be about as high which makes the white roof slightly less efficient in brutal temperatures (105-109 deg. F). However, where the white roof "shines" the most is on these hot but not too hot days that have LOTS of sun light. In my neighborhood, the humming sounds of a myriad AC condensers come together in their cacophonous ugliness. Except my outdoor unit, which is off perhaps 70% of the time. When it is really hot (100+), maximum run time is perhaps now 40-50%. This in turn leaves me with a massively oversized 4 ton unit which doesn't dehumidify as much as I want. At least, it's a 2 stage with the first stage delivering about 3 tons of cooling power. But even that is slightly oversized. Well, nothing is perfect. (At the time I got my new A/C, one contractor even wanted to put in a 5 ton single stage unit which would be even worse now). To be honest, a 2 ton unit would be about perfect for my house. Mr. Contractor, of course, would object. But that is none of my concern.

Data in a nutshell:

Average daily summer consumption between 10-22 kWh (perhaps add an extra 3 kWh during the dog days of the summer). Daily highs here range from high 80s to up to 109 deg. F. The latter is rare, though. Mostly in the mid to high 90s.

average savings per summer day: approx. 10 kWh

price: 2.7 cents of material per sqf of painted roof surface

payback on material: approx. 60 days (9 bags of hydrated lime cost me approx. \$80 at Lowe's)

attic temps before: up to 150 deg. F and after: ambient + - a few degrees, usually around 90 deg. F in the summer

temp of painted asphalt shingles: slightly above ambient (+ 5-10 deg. F max), uncoated shingles were up to 170 deg. F

total A/C run time reduction (estimated): 40%

I used an infrared thermometer for the temperature measurements. I used my online access to our smart meter for actual energy consumption. A lot of people don't like theirs, but so far I've been loving my smart meter. Instant feedback! **Reliable actual data** and no Mr. Contractor narratives from the book of cock-and-bull and shaggy-dog stories!

Application of the hydrated lime:

I used a drill with a paddle and added the hydrated lime carefully to the water until it had a creamy texture. Proper stirring is important but if the consistency varies from batch to batch, this is not too critical. I got the job done without worrying too much. I dragged the buckets up the ladder (ouch, my poor back) and poured them onto the roof, top to bottom. It was hot on those three days, and I pre-moistened the roof with the water hose a bit to prepare it for receiving the lime. I used an old paint roller pushing the paint up, thus saturating the shingles nicely from the bottom. This is important as it makes filling all these gaps much easier. It took me more bags of hydrated lime than I initially thought.

Further thoughts:

The next time I will be doing this, I will attempt to mix in some white cement and some fine quartz sand to increase adhesive strength. The cement breathes and wouldn't trap moisture. So far, after a few rain showers, the lime has held up great. A tiny amount of white dust washed off, almost untraceable on the ground (our downspouts drain into the grass or onto the driveway). I am confident that this will stay up there for quite a while. When the lime is wet, it is a bit greyish in spots but as soon as it dries up again, that seems to go away every single time. David, the white roof guy from St. Louis, is very sure that it will last at least two to three years, possibly even longer.

Conclusion:

So far, my neighbors haven't complained. They don't seem to mind. One guy even thought it looked neat. Most people in my neighborhood just keep their ACs running all day. The \$200-400 bill that they receive every month during the long Texas summer is something that they have come to accept. The price for living in Texas, so they say. My projected electric bill for the month of July is going to be \$75 which translates to about 600 kWh. Yes, I pay about 13 cents per kWh as electricity here is expensive. I do buy 100% wind, though, which is 1 cent more expensive per kWh than the average plan. Nonetheless, my 77 deg. comfort is truly affordable! It's about a third to a quarter of the average bill for houses my size and age. It's nice to know that I could turn it down to 75 deg. F without breaking the bank.

Apparently, there is someone in the neighborhood who has seen my roof and now wants to paint his as well. I am curious to see if the idea catches on. My suspicion is that it won't, though. Most often, people are concerned about the looks of a white roof and rather pay a higher bill. I like the roof color. Even my wife likes it although she was skeptical at first. It is so bright when the sun shines. It glares and shines. I say it again: I like it!

I have done quite a bit work in my attic prior to painting. It was a pain. Oftentimes, I was close to passing out, working in the terrible heat. I will not forget the first time when I stuck my head into the attic after I had painted the whole roof. It was cooler than my garage below. It felt unreal. Only spray foam can best

the white lime roof. But spray foam is 125 times as expensive as what I did. Yes, I was quoted \$10k to have my attic done. I just cannot afford that.

I am not a building scientist, just a do-it-yourself guy. My knowledge is limited, and I am a first-time home owner but I do try to learn by experimentation and by studying actual results. I have read and heard a lot about how your ceiling, especially if it is sufficiently insulated (which mine is), does only contribute a rather small percentage to your summer cooling load. I have found percentages all over the place, ranging from as little as 6% to as much as 25%. In my case, however, this is just not true. I have a one-story house with a huge roof surface, and my roof has contributed to at least half of my cooling load. I don't know what the actual percentage would be now but I think that the common numbers spread around are not right for most existing structures.

The hydrated lime is one of these things that seem too simple to be true but it really works. I would and I will do it again! It is a fantastic idea!

About the pictures: As the impartial camera cannot adjust like the eye can, photographing a white roof in the sun either leads to underexposed or overexposed images. However, I will use this detriment to my advantage to convey a sense of the reflective power of the roof.

Picture one (back of house) shows the roof clearly but leads to the rest being underexposed. As you can see, once the lime dries up and cures, this brings out the surface structure and three-dimensionality of the shingles which I find beautiful.



Picture two (back of house) shows the rest correctly exposed which leads to the roof being massively overexposed. This gives you a sense of the reflective power of the lime when the sun hits it. The albedo is great!



Pictures three and four show the front of the house.



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