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SZÉKELY ENGINEERING

EXPLANATIONS & EXAMPLES

What the Frack? ***or,*** Reports on the Demise of the Followers of Ned Ludd and Reverend Malthus Have Been Greatly Exaggerated.

"Frack!" was an exclamation oft heard passing the lips hotshot Viper pilot Lieutenant Starbuck in the original Battlestar Galactica TV series. The series was peppered with additional neologisms such as "yarns" for "years", leading one to wonder how (in light of what the term obviously stood in for) it got past the network censors.

Nowadays, of course, it refers to hydraulic fracturing, a method used to extract heretofore inaccessible deposits of petroleum and natural gas, the controversy surrounding which brings me to Ned Ludd and Reverend Thomas Robert Malthus, with the former's last name being the root for the modern coinage "Luddite" and the latter the driving force behind Paul Ehrlich's spectacularly mistaken *The Population Bomb*. Both are poster children for much that is wrong with what we think we know about our environment via relatively new 'sciences' such as ecology and climatology.

That is, back when Ben Franklin was flying kites in thunderstorms and when Faraday later began to lay the foundations for what would evolve from one branch of Physics into Electrical Engineering, Physics itself was still evolving from Philosophy to Natural Philosophy to Natural Science before it came to be called by the name we know it by today. With that evolution came the quantification that has turned Physics into the "hard" science which was the necessary condition to allow the birth of the Electrical branch of the Engineering tree.

This leads one to a concept which seems to be lost on the public at large, perhaps because we've lost touch with the lesson from fables such as The Emperor's New Clothes and old films such as the Wizard of Oz, which is that Science is ***more often wrong*** than right, and that until it gets to the point where it can spawn a branch of Engineering, it remains just so much conjecture.

This is particularly the case in nascent sciences such as climatology, professed in institutions of higher learning by the likes of physicists and geologists, relying heavily on computer models that remind me of nothing so much as the epicycles of the geocentric astronomy of the Greeks. Burt Rutan's presentation at EAA's 2010 AirVenture is as cogent an analysis on the issue as exists.

But (now that I've set the stage), to get back to fracking, there are engineering concepts that should be kept in mind when trying to sort through the psychobabble of the Malthusian Luddites who see the world coming to an end with each coming technological advance, but who, somehow, can't bring themselves to become present-day Thoreaus and leave the rest of us, who are rather fond of the fruits of modern technology, alone.

First, for fracking to work at all there has to be a relatively impervious layer of rock above the shale being fracked, between the shale and the water table – there has to be containment to maintain pressure so the fluid can actually fracture the shale instead of simply dissipating into the soil.

Second, ***nothing***, including stepping into the shower, is without risk, and the engineering aspects of risk allow actuaries to make a nice living.

Finally, life, and environmental threats to it are analog, not digital. See E&E Vol.6No.5 for an explanation of analog and digital, but with regard to the issue at hand the question is, at what concentration ***might*** the chemicals used in fracking fluids become hazardous, ***if*** they could go through solid rock to get to groundwater.

Arsenic is a poison and nitroglycerine is a high explosive, but both have medical uses.

The difference is in the dose.

Sunlight helps the body manufacture Vitamin D. Too much sunlight will give you sunburn, and might lead to skin cancer. Exposure to radioactivity occurs to every one of us every breathing moment of our lives, but neither it, nor the consequences from the Chernobyl meltdown (for other than those who fought the fires) and the Fukyshima explosions are anything like the consequences from the local radioactive fallout from a nuclear weapon.

The fire which cooks for us and warms us can also burn us out of our homes but is that to say we'd be better off at the mercy of the elements, eating our food raw? Vegans would be, to be laughingly generous about it, hard-pressed to extract protein from beans absent cooking them.

Are you getting the picture?

Let me suggest that until today's Malthusian Luddites have been alone on a mountaintop in the fury of a thunderstorm or similarly *in extremis*, they have no real appreciation for the easy life we have, and those who listen to these clowns are in a similar position, and need to get real.

Speaking of real, let's get to an explanation of engineering practices as applied to a particular issue.

Exhaust Systems ***or,*** Ventilation for Fun and Profit.

The Holland, Lincoln, and Brooklyn Battery tunnels all have ventilation buildings containing monster fans to pull exhaust gasses out of the tunnels, because they contain ferociously poisonous carbon ***mo***noxide (CO as opposed to the CO_2 we all exhale, which plants use to make oxygen as a byproduct of photosynthesis).

As the polluted air is removed, fresh air fans pull replacement air into the tunnels and this replacement process is what ventilation is all about.

In the case of the Holland Tunnel's system, it was found that if the ventilation were to be provided by air sucked through the tunnel longitudinally, it would be clipping along at 89 feet per second, or 60 mph, which might be thought to be a wee bit unworkable.

Kitchen and toilet exhaust systems similarly require this replacement or *make-up* air in order to facilitate the removal of grease and combustion products in the case of the former, and odors and airborne bacteria in the case of the latter. Make-up air in vehicle tunnels is different from that provided to kitchens and toilets in several respects.

First, make-up air to habitable or occupied spaces needs to be tempered or conditioned so as to not negate the raison d'être for building envelopes. This becomes more of an issue for kitchen (100-300 CFM or so per linear foot of exhaust hood) than for toilet (50 CFM per water closet) exhaust systems because 50 cubic feet per minute is such a small percentage (four one-thousandths of one percent) of the 12,000 cubic feet of space comprised by an average 1500 square foot dwelling that there's no real energy impact.

Second, motor vehicles in tunnels have the capability to provide micro environments for their occupants separate from the ambient environment within the tunnel.

Third, since tunnels are topologically 'outdoors' there is no energy consumption impact 'inside' a tunnel caused by bringing untempered outdoor air into the tunnel.

This last thing is far from the case with makeup air to a kitchen exhaust system, particularly one which operates all day, every day, as is the case with commercial kitchen exhaust systems.

Early systems which had no provisions for make-up air being delivered directly to a hood ended up pulling air from adjacent dining areas, which amounted to throwing away something like 8 tons of air conditioning, depending upon the size of the exhaust hood. The advantage in providing such make-up directly to a hood is that, if done right, the air goes directly into the hood exhaust, without altering the interior environment in the kitchen, which can then be conditioned to near normal temperatures in summer. Dumping untempered wintertime air into a kitchen rather than to a hood will not only make the chefs fell like they're cooking over an outdoor fire in a blizzard, but is a violation of Energy Code.

To clarify, a kitchen hood does as little to remove heat from a kitchen as does a toilet exhaust fan to un-fog a bathroom mirror after a long hot shower in winter. Designing residential kitchen hoods to exhaust nearly as much air as commercial hoods will do little to remove smoke resulting from a badly executed cooking experience and is a mistake as a residential kitchen is never closed off from the rest of a dwelling as are most commercial kitchens from adjacent dining areas. The result is that if your burned foodstuffs filled your 12,000 cubic foot dwelling with smoke, you'd still take 12 minutes to clear it with a 1000 CFM fan, and will have infiltrated enough summertime outdoor air to need about 32 tons of AC to maintain indoor conditions.

By the way, Happy Birthday Supertwerp.