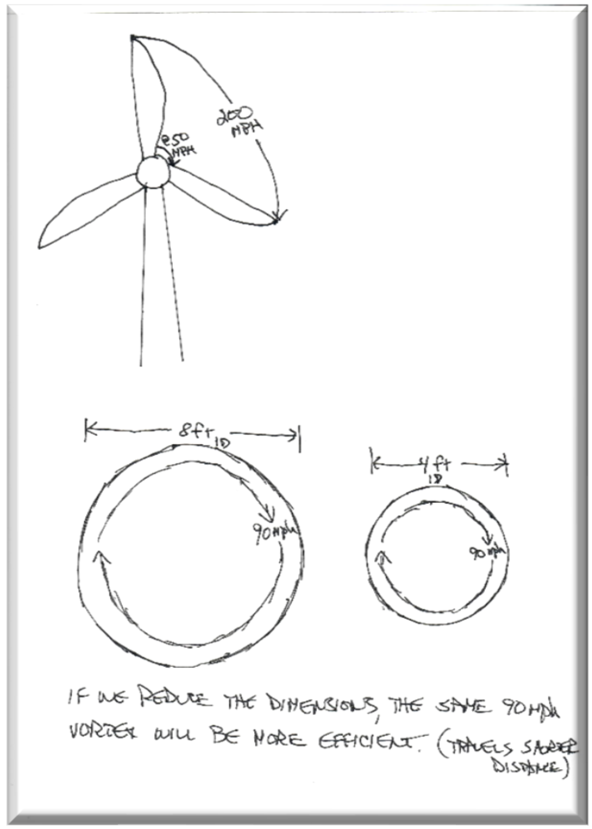
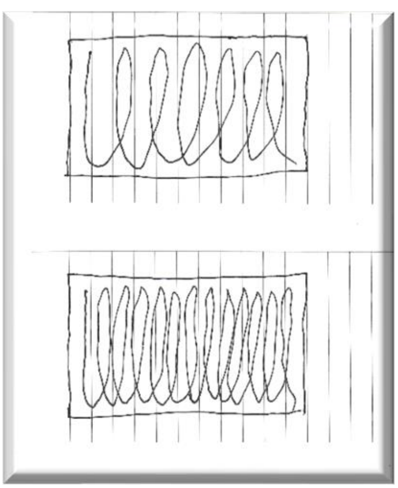
Compilation of notes covering several years



Even with all of the initial documents I had, I found information not related to combustion that helped me understand wind speed and size more than anything else. Someone had told me about the speed that a wind turbine blade turns is sometimes as much as 200mph. The illusion that the three 85 foot long blades in combination are not spinning that fast is what fools most people. The reason is that the tips of the blades are spinning around at 200mph, while the portion of the blades closest to the center hub may only be turning at 50mph or close to that. Knowing from the first systems developed by Bob Hasselbring at General Electric in Shelbyville, Indiana in the late 60s and early 70s actually utilized an air flow of 90mph, when we needed to come up with a small system that would be able to be put into shipping cargo containers, a reduction in size was deemed possible. Discussions with Bob helped me understand how that high level of turbulence was going to be beneficial, especially when we reduced the size of the chamber.

Bob had told me that the first unit he made, the 8' by 11' chamber, could actually do 2 tons per hour, but since they figured most people would be leary of that, they used 1 ½ tons per hour on the brochures. So, when I started my modification, I used some of the principles of trying to increase performance with miniaturization. I was surprised to be able to find so much information about micro combustion, and how a reduction in size could allow us to not only meet the previous specs, but possibly surpass them.

Prior to my starting my energy business (which was prior to my starting on the vortex technology), I was a top vendor to Motorola, achieving awards in both sales performance, and in being named to the vendor design team at Motorola on the StarTac phones. The focus they had was to cram as much as possible into the tiny frame they wanted. I remember one engineer joking that "bigger is better" needs to be tossed out of our mindset. He used more colorful language!



When Ren told me about the capacity of the smaller unit could be increased with more than the two secondary air portals, and describing it as pushing the coil together to allow more coils to be processed, it suddenly made sense. The turns, or revolutions of the “coils” represent the waste material as it moves within the vortex. The waste material burns in full suspension, creating the vortical movement. By compressing the coils, and adding more coils, we increase the amount of waste material processed, or the capacity of the system.

The two areas that performed better than we had expected was the amount of time to reach temperature, and the amount of waste materials we could process per hour. We never expected to reach the low end of the operating temperature of 1,800°F so quickly, and we had actually only expected (hoped) it would be at least 2 tons per hour, and preferably 3 tons. In fact, because of the reduction in size, and the use of high powered blowers, along with the other changes, we calculated that we could easily do 4 tons or more per hour. Again, keeping with the tradition of the initial system, we kept all of our performance criteria on the conservative side.

The following is a summary of thousands of pages of documents, articles, personal notes and various other materials.

1. Reviewing previous patents on various vortex designs:
    a. 3,577,940 Bob Hasselbring and Bob Shields, filed Oct 27, 1969 and patented May 11, 1971
    b. 3,727,563 Bob Hasselbring and Bob Shields, filed July 2, 1971 and patented April 17, 1973

2. Meetings, contacts, conversations:
    a. Bob Thurnau conversations, emails, and his document he wrote: "High-temperature Vortex Incinerator." Bob worked for the US EPA in Cincinnati, and met with Bob Hasselbring and my Dad. Bob's document discussed the good and bad of incineration, even with a vortex. His demonstrated design was nothing close to the large chamber system invented by Bob and General Electric. The document, along with the discussions with Bob T, helped confirm the positive attributes of Bob H.'s design.
    b. I met with a scientist with the EPA in the Chicago office, who offered the EPA's assistance in finalizing the design, building, and subsequent research. He offered a close partnership between us and the EPA, something that still exists today.
    c. In addition, I was very fortunate to use a connection and relationship with Bill Rucklehaus, who was the first Director of the US EPA. His wife Jill commemorated the building where the first unit was being demonstrated.
    d. Met with engineers on multiple occasions that had related backgrounds. I met with senior engineers with the University of Wisconsin in Madison, Wisconsin, as well as top scientists with the US Department of Forestry and the Bureau of Land Management.
    e. I consulted with engineers and entrepreneurs that were involved with various aspects of waste management, destruction of waste materials, and combustion services. I researched and studied issues with waste management and destruction from around the world.
    f. The most valuable thing I did was to have hundreds of hours of conversations with Bob Hasselbring, as well as letters, and a few face to face meetings. Bob's knowledge was amazing, and his memory was almost frightening!! He could remember details such as names, specifications, and even dates. Bob was an amazing mentor. He would finish off each conversation with a quick joke, anecdote, or even a prayer. He was truly the father of vortex combustion. He would also give me challenges, and wanted me to try to find an answer to an issue that we had previously discussed. Shortly before he died, he told me that I had become the world's utmost authority on vortex combustion, and when I said "that and 5 bucks won't even buy me a coffee from Starbucks," he laughed. That was one of the last conversations we had.

    With all of this support, as well as being able to talk with a handful of the engineers that worked at GE or later Wellman Thermal Systems, I literally felt that I had an army watching my backside.

3. Research with hundreds of articles on:
    a. Combustion
        i. Complete vs. incomplete
        ii. Time, Temperature, and Turbulence
    b. Gasification
    c. Pyrolysis
    d. Three Laws of Thermodynamics
    e. Steam conditions and characteristics
    f. Gaseous emissions

g. Comparisons of various types of incinerators, burners, and furnaces

4. Studying the principles and dynamics of wind turbines

5. Properties of miniaturization and size to output. One of the concepts I was told about when I was working with the Motorola engineers was that our advances in miniaturization mean that we can dramatically increase performance as we can "put more in a smaller package." During my work with Motorola, I was introduced to Gordon Moore's Law on Miniaturization. In the mid 60s, Gordon Moore suggested that the number of transistors that could be packed into an integrated circuit could double every two years. Even though I was not obviously working with such tiny devices, the idea was used in all sorts of products. Even complex systems like cars could put more performance into a smaller package.

6. Learning from Ren Jhala about compressing coils to create additional capacity.

7. Micro combustion is a concept that was developed with the advent of miniaturization, allowing higher rates of efficiency while using smaller components. Micro combustion was "invented" in the late 90's, showing a higher energy density. This is a good place to define the word energy. Simply put, it's the capacity to do work. Energy is sometimes thought of as electricity, but electricity is the flow of an electrical charge. Energy is also used to describe the actual source of fuel that can be used to generate electricity, such as coal, natural gas, oil or nuclear power. Although a vortex unit, plus a waste heat boiler and steam turbine generator combine form an extremely small method of waste-to-energy compared to the much more recognized behemoth power plants, it might not be able to be called micro combustion. But a compact version of the original size most definitely runs alongside the principles of miniaturization and micro combustion.

8. Stoichiometric combustion is an "ideal" or "theoretical" concept where a certain mixture of oxygen and a fuel will create the most heat possible, and reach a maximum level of efficiency. With this ideal process, there will not be any combustible materials remaining and no excess air. Reaching 100% stoichiometric burning is impossible, but because we have complete control over the atmosphere in the chamber, we can reach 99.998%, leaving .002% emissions, which is comparable to 20 parts per million, well below the EPA's standards of 20 ppm for even a single item found in the effluent or exhaust gases.

9. Following basics of the scientific method… (have a question about something, create a unique hypothesis, some form of experimentation, then draw a conclusion), we made a miniature model that was 18 inches wide by two feet long inside dimensions. We used a refractory brick, and had a removable front wall to make observations. For these tests, we used shredded tires as the input. We expected to see the rubber burning, but instead, the shredded pieces literally flashed and burned extremely fast. This can be seen in the videos. These tests proved that reduction in size, or miniaturization, would not restrict us from getting the results we wanted. Once the full-sized system was built, we once again used shredded rubber to test, and the results were much better than expected. We also used wood that was chipped to a 1 to 2 inch chip size, and again, the results were much better than expected. (Wood was ideal for these tests, since it falls somewhat in the middle of the BTU levels. Garbage has 4,000 BTUs per pound; wood has 8,000 BTUs per pound, and tires have 16,000 BTUs per pound. Also, wood was easier to test with since a wood chipper was easier to use than building a different pneumatic conveyor specifically for these tests.) We were even more surprised that we were able to reach the lower end of the operating temperature (1,800°F to 2,200°F) within only a few minutes and with only 40% of the air intake. All of these results together gave us results much greater than we initially thought would happen. Another reason to use wood is that it was easy to calculate the capacity and value of other waste materials, with higher or even lower BTU or thermal values.