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Offgassing

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This is an extensive study by the University of Wisconsin-Madison that was presented to us by the state of New Mexico.

40 years of research and development of self-sufficient housing made from recycled materials.

Development of Earth friendly and people friendly community living concepts that require little or no mortgage payment and no utility bills.

The cover page of which is here. It can be obtained through the University of Wisconsin-Madison, Madison, Wisconsin, 53706.

It would probably cost something to get it.



The evolution of the Earthship building concept in addition to the evolution of the self-sufficient systems, i.e., power, water and sewage is an enormous undertaking. This is why we have given so little attention to the few who consider off-gassing a problem or even a reality. There has never been one instance of illness or even awareness of any off-gassing of tires in 30 years of research and development. Therefore, in our minds at Earthship Global, it is looming out there as a hypothetical issue coming from those who have never experienced the concept in person. In view of the above, and the serious issues surrounding current tire disposal globally, we think (but accept the fact) that those who are trying to make an issue out of this are irresponsible themselves.

Furthermore, the Earthship building concept can be implemented with other forms of thermal mass besides tires rammed with earth.

However, the reason we use tires is because they are the most economical and environmentally appropriate way to achieve both thermal mass and structure in an actively thermal dynamic building. Anyone who has spent 30 years trying to make human existence on this planet less painful to the planet and the humans themselves is not going to risk exposing people to a hazardous situation. We simply do not see disproving off-gassing any further than the aforementioned technical report (and our own experience) as an appropriate place to spend time and money given the serious housing and energy issues that our current method of living is now presenting.

Cover Page from the New Mexico Environmental Department:

From: New Mexico Environmental Department - Solid Waste Bureau
re: University of Wisconsin Study

"Rather than trying to pull out specific parts of the study that could be used to let people know that scrap tires are not a problem with respect to out-gassing, I decided to have a copy made of the whole report and send it to you. You can use whatever information in the report you choose." The title of the report is "Use of Scrap Tires in Civil and Environmental Construction" May 10, 1995. Environmental Geo-technics Report No. 95-2. Geo-technical Engineering Program Department of Civil & Environmental Engineering. Did you know? Tires are being recommended to absorb off-gassing produced by waste water from communities, industries, and agriculture activities. Here are some highlights from the report: "If tires are reused as a construction material, the unique properties of tires can once again be exploited in a beneficial manner (Ahmed 1993). The benefits of using scrap tires are particularly enhanced if they can be used to replace virgin construction materials made from nonrenewable resources. Additionally, scrap tires are shown to have significant sorption capacity for organic liquids and vapors (Park, Kim, and Edil 1993). Recent research indicated that shredded tires do not show any likelihood of being a hazardous waste material or of having adverse effects on groundwater quality (Edil and Bosscher 1992)." "There may be some concern about leachate quality since scrap tires are considered a waste material. Laboratory and field evidence available does not show any likelihood of scrap tires being a hazardous waste or having potential for significant adverse effects on water quality (Edil and Bosscher 1992)." "In order to obtain an early evaluation of potential environmental problems, duplicate EP toxicity and AFS leaching tests were performed on tire chip samples by the State Laboratory of Hygiene (Edil, Bosscher, and Eldin, 1990). The duplicate results showed excellent correlation for all substances (see Appendix C [in report]). These test results indicate that the shredded automobile tire samples show no likelihood of being a hazardous waste." "Styrene-butadiene rubber is the most important synthetic rubber used by the tire industry. This material is known to absorb large amounts of hazardous organic chemicals from the surrounding environment (Park, Kim, and Edil, 1992). This can actually impart certain beneficial environmental attributes to shredded tires. In summary, shredded tires leach very small amounts of substances compared to other wastes. By comparison to other wastes for which leach test and

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environmental monitoring data are available, the tire leach data indicate little or no likelihood of shredded tires to have effects on ground water." "This study indicates potential problems under either acidic or basic conditions, i.e., if waste tires are utilized in locations where exposure to pH is expected." "The shredded tires appear to release no base-neutral regulated organics, including PAH compounds that I suggested would be the most likely substances to be extracted from tires....I suspect that several of the substances were released from surface coatings rather than leached from the tire material....."

My summary judgment is that the test results indicate that shredded automobile tires leach very small amounts of substances compared to other wastes. The leaching behavior does not indicate that use of tires in earthen embankments or other structures would constitute a threat to groundwater or surface water. The minor amount of leaching of indicators and some metals suggests that tires are best used in buried locations above the water table, rather than in surface applications or in contact with open water bodies. Use of shredded tires need not be restricted in ways different from those placed on whole tires. The test results indicate that waste automobile tires are extremely unlikely to be classified as a hazardous waste." - from a letter by Robert Grefe, State of Wisconsin in "The Report". "Desirable disposal methods [of tires] should at least include three facets: (1) minimum environmental impact (2) maximum reutilization of potential resources (3) economic feasibility" "based upon all of these studies, it can be said that the potential leaching of toxic pollutants from scrap tires is minimal"

The following is an e-mail from an engineer in Alamosa, CO. As an engineer, I feel the need to respond personally to the technical content of the recent letter printed by the Toronto Star. This letter raises several concerns which in my judgment are not technically valid. I would like to preface my comments by stating that I am NOT an Earthship enthusiast, Earthship owner, and am in no way affiliated with Solar Survival Architecture. I AM an engineer with training and experience in dealing with these issues who finds the Earthship concept to be an interesting and novel approach to sustainable living.

What is "carbon black"? The following description of "carbon black" is found in Appendix A of the National Institute for Occupational Safety and Health (NIOSH) "Pocket Guide to Chemical Hazards": NIOSH considers "Carbon Black" to be the material consisting of more than 80% elemental carbon in the form of near-spherical colloidal particles and coalesced particle aggregates of colloidal size that is obtained by the partial combustion or thermal decomposition of hydrocarbons. NIOSH also classifies carbon black as a class A (known) carcinogen. However, to assess the risks to human health and environment posed by the use of recycled tires in Earthships, one must look at the pathways of exposure, and the state in which this potential contaminant exists. The letter states that, "A tire under proper conditions will break down into the above products." "The proper conditions" for rubber to degrade would be: high temperature, exposure to light, or the presence of strong oxidizing chemicals. None of these conditions exist when a tire is entombed in an Earthship wall surrounded by packed earth, vapor barrier, stucco, and paint. The argument has been made that tires must off-gas because "old tires smell." The reason "old tires smell" is due to the photo degradation of rubber. Essentially what happens is that photons from light bombard the rubber and knock atoms from the long rubber polymer molecules. This causes the rubber to degrade, and smaller molecules to vaporize. In the absence of light, this does not happen.

Tires are not exposed to light when used in an Earthship. In order for the tires to affect the indoor air quality of an Earthship, the tires must off-gas vapors which must travel from the tires, through the walls, into the living space of the Earthship. The production of such vapors will be proportional to the vapor pressure of the compounds producing the vapors. The NIOSH pocket guide lists the vapor pressure of carbon black as "0 mm (approx.)." This is an extremely low vapor pressure. In other words, this chemical produces almost no vapor. What this means is that the potential for tires to affect indoor air quality will be severely limited by the extremely low vapor pressure of the source chemical.

The letter also states, "We do not need these products leaching into our water systems." In order for a tire to affect water quality, it must come into contact with water, and release chemicals into the water. In a properly designed and constructed Earthship, there will be no flux of water through the wall. Therefore, no water will contact the tire. In the unlikely event that water should contact the tire, the water will not become contaminated because carbon black is insoluble in water (NIOSH Pocket Guide). The letter also makes reference to the millions of dollars private industry is spending to find "safe, environmental ways to dispose of discarded tires." One must consider the problems created by discarded tires. Once a tire is placed in an inert environment such as a landfill it does not pose a chemical threat to the environment.

The problem with land-filling tires is the enormous volume of discarded tires. Landfill space is very expensive in 1990s America, thereby making the land-filling of tires an expensive disposal alternative. Tires also tend to collect methane in a landfill, become negatively buoyant, and create a physical problem in the landfill. Reusing a tire in an Earthship, where it becomes a beneficial resource, and spends its future in an inert setting is an ideal ultimate use for discarded tires. Large scale private industry does not consider this to be a viable alternative because it is not profitable to them.

In order to place the issue of tire off-gassing into perspective, one might consider other common chemicals affecting indoor air quality. Formaldehyde is a chemical used in the manufacture of textiles and carpets commonly located in the living space of human dwellings. It is also classified by NIOSH as a known carcinogen. The vapor pressure of formaldehyde is 470 kPa at standard temperature (CRC Handbook of Chemistry and Physics). This means that formaldehyde will readily travel into the breathing space of a dwelling, especially when the source (carpet) is located within the occupied space of a dwelling. This is a much more direct pathway of exposure than that of Earthship tires. One further point to be made is that the concentration of carbon black in air can be measured, and standards for acceptable exposure do exist. The NIOSH recommended exposure limit (REL) for carbon black is 3.5 mg/m³ (ten hour time weighted average). This is a workplace standard, so a lower value would be appropriate for residential situations.

A study could be performed in several Earthships of varying age measuring the byproducts of rubber degradation. These results could then be used to perform a risk assessment of the use of tires in Earthships. **My intuition is that this risk would be several**

orders of magnitude lower than the risk posed by activities such as living in a house with new carpet, eating peanut butter, driving a car, or smoking cigarettes. In the absence of such a study, my personal judgment is that the risks of living in a properly designed and constructed Earthship are negligible compared to the environmental benefits of Earthship living. Chris Kaiser, Alamosa, CO PS If anyone is interested in looking into this on their own, the CAS# for carbon black is 1333-86-4, and the RTECS# is FF5800000.

-Chris Kaiser

Tires are hazardous in piles, not Earthships.

About Earthship Biotechure

Earthship **construction drawings** are designed to meet standard building code requirements so you can get a permit no matter where you are. **Earthship Biotechure is beyond LEED Architecture. Earthships are green buildings that meet standard building codes.** EarthshipBiotechure is based on the work of principal architect, **Michael Reynolds**. (see: [media resume](#))

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