Does in-floor hydronic heating disturb the electromagnetic environment in a house?

It has been suggested that the movement of water through coils embedded in a floor might affect sensitive people. We tested the idea using sensitive instruments and found no difference whether the water was moving or not.

Keywords: *radiant floor, in-floor heat, hydronic heat, EMF, EMR, radiation, Schumann Resonance*

Heating systems for sensitive people

A small subset of people is much more sensitive to air pollution and electromagnetic radiation than the rest of the population. These unfortunate individuals often have trouble living in houses heated with wood stoves, gas heaters or electric heaters. Heating the house by pumping hot water through pipes embedded in the floor (radiant floor heat / in-floor heating) avoids the fumes and radiation of other common heating systems, and is used in many houses purposely built for highly sensitive people.

However, some people suggest that the movement of water through the floor could alter the electromagnetic environment and be a problem for highly sensitive people. This concern led the designer of an apartment building in Zurich, Switzerland to specify that the floor coils should not go under the beds in the bedrooms.

We decided to investigate whether such measures are warranted.

Summary of the test

We did a test on a floor heating system in a house in rural Arizona. The house was specially built for someone with severe chemical and electrical sensitivities. It was located off the grid in a low-radiation rural area. The construction and location of the house allowed us to do the measurements without interference from any sort of electrical equipment.

The picture on the first page shows the coil before the concrete slab was poured around it.

We used a sophisticated gaussmeter that could measure the natural frequencies from the earth, including the important Schumann Resonances (about 8 to 45 hertz). The instrument was placed directly on top of the floor. We measured the magnetic and electric fields with the heating system circulation pump on and off. We also used a compass to detect any DC magnetic disturbances.

See the appendix for further details about the instruments and how the tests were done.

Results

We measured the magnetic and electric fields in six places on the floor. We recorded for the frequency ranges 50 Hz to 400 kHz and 5 Hz to 400 kHz. The wider range includes the natural Schumann frequencies (8 Hz to 45 Hz) that are considered essential for human health.

Ordinary consumer-grade instruments have a narrower frequency range, which is typically from 50 Hz to about 1 kHz. The narrower the range, the lower the readings. All readings were at the bottom end of the instrument's sensitivity, which are 0.1 nanotesla (0.001 milligauss) and 1 V/m.

Table 1 shows magnetic readings for man-made frequencies. All readings were stable.

Table 1: Magnetic readings (50 Hz – 400 kHz)

Position	Pump off	Pump on
A	0.2	0.2
B	0.2	0.2
C	0.2	0.2
D	0.2	0.2
E	0.2	0.2
F	0.2	0.2

All numbers in nanotesla. 0.2 nanotesla = 0.002 milligauss

The readings in Table 2 include natural frequencies, such as the Schumann resonance, which fluctuates considerably, due to global thunderstorms. The numbers shown were the highest reading in the fluctuation range observed. If an averaging instrument had been available, it is likely that all the numbers in Table 2 would be identical, just as they are in Table 1.

Table 2: Magnetic field, wide-band (5 Hz – 400 kHz)

Position	Pump off	Pump on
A	3.0	3.2
B	3.6	3.6
C	3.7	3.5
D	3.6	3.4
E	3.4	3.3
F	3.6	3.8

Highest number in fluctuation range. All numbers in nanotesla.
3 nanotesla = 0.030 milligauss.

As the tables clearly show, it made no difference whether the water was moving in the coil or not.

Measuring magnetic fields in the 5 Hz to 400 kHz range at Position D. The pipe embedded in the concrete floor goes between the bottom and the top of the picture.

The electrical fields were similarly measured, with the same result that no changes could be detected whether the water was moving or not, as shown in Tables 3 and 4.

Table 3: Electric field (50 Hz – 400 kHz)

Position	Pump off	Pump on
A	2.1	2.1
B	2.5	2.5
C	2.1	2.1
D	2.5	2.5
E	2.5	2.5
F	2.5	2.1

All numbers in volts/meter.

Table 4: Electric field, wide-band (5 Hz – 400 kHz)

Position	Pump off	Pump on
A	2.3	2.3
B	2.7	2.3
C	2.3	2.3
D	2.3	2.3
E	2.8	2.8
F	2.7	2.3

Checking DC magnetic fields with a compass.

A compass was placed on the floor and slowly moved 24 inches (60 cm) horizontally across the coils, while the needle was watched carefully. The needle would change direction if a DC magnetic field was present around the tubes. None were observed.

Discussion

Early versions of floor heating systems used copper pipes, which could carry stray electricity in case of poorly done grounding. Copper pipes tend to corrode when embedded in concrete and have been supplanted by plastic PEX pipes for many years.

It is possible that the belief that these heating systems can cause problems is a hold-over form the days of copper tubing.

Water is not a good conductor and cannot be magnetized. It is thus unlikely to be able to modify the electromagnetic environment. But water usually contains minerals, including iron particles, which can be magnetized. Their fields are very weak and moving them at the slow speeds of a heating system would produce a very weak magnetic field. Moreover, since the particles are suspended in the water, they will probably tend to orient themselves in random directions, which should largely cancel out the fields from each particle. It was no surprise that we were not able to detect anything.

The water used for the heating system we tested came from the household well, which had elevated iron content, though not beyond EPA regulations.

We considered it conceivable that the movement of the water could cause the particles to orient themselves with the result that a steady DC magnetic field was created. So we tested for a DC magnetic field as well, but found none.

We did our measurements in a house with exceptionally low ambient radiation levels. The magnetic level was at least a hundred times lower than what is found in a suburban house. The electric field was similarly reduced. Any significant changes to the electromagnetic environment should therefore be easy to notice in our test.

We measured for a wide range of frequencies, including no frequency (DC).

The natural fluctuations in the lowest frequencies made reading the instrument difficult. Slight variations of the highest values were seen, though there was no pattern to indicate they were associated with whether the water was moving or not. It appears that if a recording, or automatically averaging instrument was available, all the numbers in Tables 2, 3 and 4 would be identical, just as they are in Table 1.

We thus conclude that we failed to find evidence that water moving inside a plastic tube embedded in a concrete floor can create any changes to the magnetic and electric environment. If there is any, it is so low that it makes no difference compared to the ambient radiation in even the most low-radiation house.

If someone thinks their radiant floor heating system affects them, it would be prudent to look at affects from the pump, heater or control system, rather than the movement of the water. If that can be ruled out, it could be considered to replace the water with distilled water to omit the possibility of iron particles or rare-earth minerals.

2018

Appendix: How we did the measurements

The measurements were done in a house located three miles (4.5 km) from any electrical power line, and in a low-radiation rural area. During the measurements, the house was fully electrically separated from the outbuilding housing the solar system (all wires were disconnected, using a kill switch).

The circulation pump necessary to run the heating system was located in the outbuilding together with its power source. The water entered and exited the house via underground plastic PEX pipes.

We measured in a central part of the house where the embedded pipes ran parallel and roughly aligned north-south. The measured area is seen at the center-right in the picture on page 1. The pipes were ½ inch (12 millimeter) PEX plastic and about 3½ inches (85 millimeters) below the surface of the tiled floor.

We did the measurements in the early afternoon on November 22, 2017. It was a clear, sunny day with high air pressure and no thunderstorms in the region (thunderstorms could greatly affect the readings).

The instrument used was a ME 3951A from Gigahertz Solutions in Germany. It has a certified range from 5 hertz to 400 kilohertz and built-in filters to measure narrower frequency bands. The Schumann frequencies start at 8 hertz and go up to 45 hertz.

Since we couldn't see the exact location of the coils embedded in the floor, we measured in six locations (positions A through F). Each position was two inches (5 cm) apart to be sure at least one was on top of an embedded PEX pipe.

The instrument was not grounded for the electric field measurement. When it was read, the operator was no closer than two feet (60 cm) to minimize artefacts.

Ambient readings were taken with the instrument on the ground in the yard, and about 75 ft (24 m) from the house.

Table 5: Ambient outdoor radiation

	Magnetic nT	**Electric V/m**
wide-band 5 Hz – 400 kHz	2.6	2.4
reduced band 50 Hz – 400 kHz	0.2	1.8