

Thoron: the unrecognized carcinogen in earthen dwellings typical to rural Africa and Asia

Margaret Chege and Catherine Nyambura
Kenyatta University, Kenya

Talk Structure

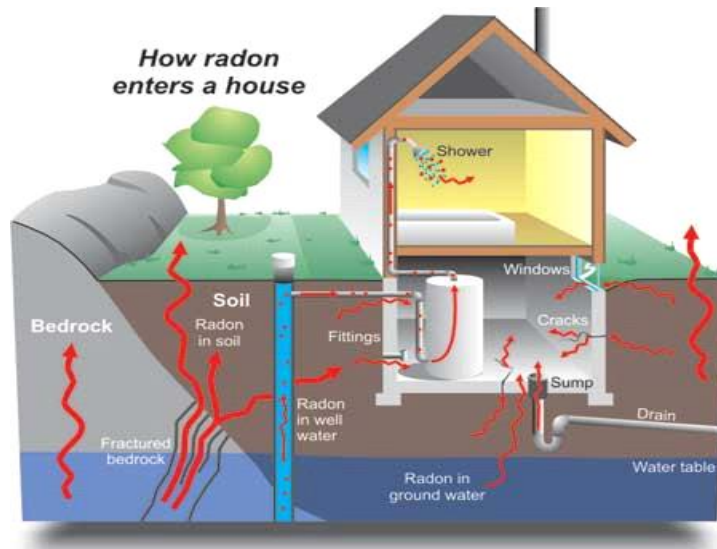
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Introduction

- Thoron half-life - 55.6 s
- In most cases, not considered a risk
 - in the perspective of modern houses



- However, may be elevated in ground floor, basement
- Enters from soil through cracks, crevices, joints



<https://springfieldhealthyhomes.org/radon/>

- Looked at for example from rural Africa and Asia perspective, may be misleading

- In some rural areas of Asia and Africa - soil is the main building material.
- In Kenya for example, soil makes wall, floor, e.g.



- Not necessarily out of poverty; rather way of life
- Source of thoron in contact with indoor air

Why the risk

(1) ^{232}Th level in soil

- ^{232}Th average in soil 45 Bq/kg while ^{238}U average 35 Bq/kg
- Areas with elevated ^{232}Th levels in soil reported, eg

Country	Region	^{232}Th conc. (Bq/kg)	Ref
Kenya	Mrima Hill	500	Kebwaro et al 2011
	Homa Mountain	410	Otwoma et al 2012
	Lambwe East	1397	Achola et al 2012

- Same soil may be used for construction

(2) Thoron exhalation rate

- Thoron exhalation rate from surface soil often higher compared to radon; example

Country	mBq/m ² s	mBq/m ² s	Citation
indonesia	2008	48.11	Syarbaini and Pudjadi et al 2015
Japan	1210	12	Hosoda et al, 2009
India	5402	73.6	Midhum et al 2017

– Thoron input in air higher

(3) Short half-life of thoron

- Curse in earthen dwellings
- Let number of airborne thoron atoms in unit time equals the number of radon atoms (N)

$$Activity = \frac{0.693N}{T_{1/2}}$$

$$A_{thoron} = 5,936A_{Radon}$$

- Significantly higher thoron progeny input rate
 - Progeny responsible for cancer

- Say 99.9% of thoron activity – progeny attach to surfaces, still;

$$0.1\%(A_{thoron}) \approx 6A_{Radon}$$

– High concentration - Increased risk

- NOTE: requires a steady state concentration of 17 thoron atoms to produce the same activity as 100,000 radon atoms.
 - Thoron may be an issue even in modern dwellings if building material contains ^{232}Th

(4) Thoron progeny airborne considerably longer

- Longer exposure time – increased risk

(5) Higher energy

- Higher probability of causing sufficient damage to cause cancer

Conclusion

- Have dwellings made of soil in parts of Africa and Asia.
- On average, ^{232}Th (thoron source) in soil is higher than ^{238}U (radon source).
- Thoron exhalation rate from surface soil is often higher than that of radon.
- For equal number of airborne radon, thoron atoms, thoron exhalation is considerably higher
- Thoron progeny are airborne for longer period of time
- Collectively, thoron progeny have more energy than radon progeny
- Risk - function of concentration, exposure time, energy; hence thoron possible carcinogen in earthen dwellings

Recommendation

- More research on the isotopes in earthen dwellings
- Epidemiological studies to investigate the link between living in earthen dwellings and risk of cancer.

Thank you for your attention