Urgent change of tack needed for tired tyres

How a well-intentioned tyre recycling program risks becoming a micro-pollution disaster

A shocking one billion waste tyres[1] are generated worldwide each year. Working out what to do with them is one of the biggest waste challenges we face today.

The Australian government is investing in solutions[2] that shreds tyres into 'rubber crumb' to build playground mats and infill artificial turf. Unfortunately, this is not the solution it seems.

A new study[3] shows rubber crumb playgrounds release an estimated 1.2 million crumbs into the immediate environment (within four meters of these sites) on average. This is even more alarming given the proximity of the test sites to Great Barrier Reef catchment, and other research suggesting tyre chemicals may have toxic health effects on both marine and human life.

Experts warn immediate steps are needed to ensure government-endorsed recycling programs don't solve a problem, while quietly causing another.

What is rubber crumb?

'**Rubber crumb**' is a construction material made of small rubber fragments, around the size of a peppercorn, typically produced by shredding car tyres.

By binding the crumbs together, a soft surface can be created for playgrounds and running tracks. It can also be left in crumb form and sprinkled onto artificial turf, to soften it for impact and keep it standing upright.

The popularity of rubber crumb is skyrocketing. According to government estimates, around 80,000 tonnes of rubber crumb[4] were made in Australia in 2018-2019 alone. These numbers are likely much higher today, given the increase in demand.

Part of this uptake comes directly from the government's Tyre Stewardship Australia (TSA) program[5]. This program aims to "generate new, sustainable markets for end-of-life tyres. While also ensuring that end-of-life tyres do not cause environmental or social harm."

With 48 million car tyres[6] reaching the end of their useful life every year in Australia alone, programs like this are important and foresighted.

Unfortunately, rubber crumb, when used the wrong way, has the potential for significant harm to the humans and the environment.

Toxic tyres

Tyres contain a myriad of hazardous chemicals. Consequently, rubber crumb does too[7].

Most worrying[8] to health experts, are a group of organic materials found in rubber crumb[9] known as 'polycystic aromatic hydrocarbons' (PAHs). Naphthalene is perhaps the most famous PAH, once used in mothballs before studies showed it causes cancer[10] in mice and rats.

A 2019 study documented 306 individual chemicals[11] in rubber crumb samples from sports fields. Fifty-two were known cancer causing agents ('carcinogens') and a further 197 were suspected carcinogens – many of which had not been formally tested.

Fish fatalities

Given this list of dangerous ingredients, it might be unsurprising scientific studies are revealing the disastrous effects tyre-related chemicals can have on marine and wildlife.

A 2021 paper[12] published in the prestigious journal Science recently revealed a chemical found globally in tyres, '6PPD-quinone', is highly deadly to fish. Even at very low (parts per billion) concentrations.

Even more troubling, they documented toxic levels of this chemical in creeks across the United States west coast. Creeks where 40-90% of adult coho salmon die[13] before spawning each year.

The researchers suggest these deaths are caused by tiny rubber crumb-like particles that flake off tyres on the road and are washed into storm drains[14].

Other similar reports show rubber crumb leaches "chemicals of environmental concern"[9] into water and fish die in water contaminated with these chemicals[15].

On land, sprinkling rubber crumbs onto soil causes earthworms living in the soil to become significantly underweight[16] compared to worms in untreated soil.

Cancer concerns

Even closer to home, whether chemicals in rubber crumb can affect human health remains controversial.

Amy Griffiths[17], a head soccer coach at the University of Washington, was one of the first to bring this issue to the public's attention[18].

In 2009, she came to the press[19] with a list[20] of athletes she claimed showed unusually high levels of cancer. This list, which in 2019 stood at 260[21], was around 75% soccer players, who play regularly on artificial turf and thus, are frequently exposed to rubber crumb.

Two key features of her list caused concern. First, goalies (who spend the most time on the ground) seemed to be over-represented. They made up 59% of the list, despite only representing 10% of players. Second, one expert commentator[22] claimed certain specific cancers, like lymphoma, were much more prevalent in the group than in the normal population.

Hearteningly, majority opinion among scientists suggests human health should not be significantly affected, though a smaller (but vocal group) disagree. More research is needed, particularly to gauge potential health effects in children who are the top users of rubber crumb playgrounds.

The pollution problem

While human health effects of rubber crumb remain unresolved, the huge pollution issue caused by rubber crumb is crystal clear.

Anyone who has used these playgrounds will have seen how quickly they degrade. Seemingly even within weeks of installation, crumbs and larger chunks break away and travel far and wide. This may be due to simple wear and tear, mowing, UV exposure or poor fabrication.

The pollution burden from rubber crumb is only starting to be documented.

Tangaroa Blue Foundation[23] is working to change this, alongside partners AUSMAP[24] and Macquarie University[25]. Tangaroa Blue coordinates the Australian Marine Debris Initiative (AMDI) – a national program focused on the removal and prevention of marine debris.

By testing samples from the areas surrounding playgrounds along the Great Barrier Reef coast, they have shown the loss of rubber crumb from these sites is dramatic. They estimate an average 1.2 million crumbs within just the first four metres surrounding the sites. One site recording a whopping 2.5 million rubber pieces.

Many of these playgrounds are within metres of beaches and waterways, posing a clear risk of environmental harm.

The limited longevity of these surfaces shows that rubber crumb projects don't divert end-of-life tyres from landfill, they simply delay their way. Worse still, it releases potentially toxic rubber particles directly into the environment.

Being in a form that is not bound together, this issue is compounded for rubber crumb used on artificial turf fields. Environmental scientists are particularly concerned[9] about the huge transfer of rubber crumbs into the waterways that is inevitable following flooding on artificial turf fields.

What's next?

As a society, we do need a solution to manage the millions of waste tyres generated each year.

Tyre Stewardship Australia has invested over $6 million dollars on 43 different tyre recycling and repurposing programs. Unfortunately, it remains unclear if any of these schemes are truly environmentally friendly.

Certainty can only be gained by thorough and independent assessment of the full life cycle of recycled products. Something that is not currently being done sufficiently, if at all.

Other projects[26] that fully integrate tyre rubber into their products will, at least, avoid the pollution burden of rubber crumb. In manufacturing, incorporating tyre biproducts into asphalt and concrete has been shown to improve the durability and strength-to-weight ratio[27] of these materials.

However, whether tyre chemicals could leach out into stormwater must be formally assessed to avoid further toxicity problems in urban waterways.

The Tyre Stewardship Australia program is proud to state it operates with input from a variety of key stakeholders. Unfortunately, these stakeholders are mostly tyre and automotive companies who pay the levy supporting the scheme.

Consultation with environmental experts and independent research is what is urgently needed to ensure future tyre recycling programs are truly beneficial for our already fragile ecosystem.

References

1. Motshabi 2020 Enviro Sci & Pollut Res Trends in the management of waste tyres and recent experimental approaches in the analysis of polycyclic aromatic hydrocarbons (PAHs) from rubber crumbs
2. https://www.tyrestewardship.org.au/project/
3. ReefClean AUSMAP Rubber Crumb Loss Report 2021 www.reefclean.org
4. https://www.environment.gov.au/system/files/resources/4fe81607-c549-465b-b8b0-759ec0a1a683/files/tyre-flows-recycling-analysis.pdf
5. https://www.tyrestewardship.org.au/
6. https://www.awe.gov.au/sites/default/files/documents/35159-fs-tps.pdf
7. Gomes 2021 J Haz Mat A review of potentially harmful chemicals in crumb rubber used in synthetic football pitches
8. Mohajerani 2020 Resources, Conservation & Recycling Recycling waste rubber tyres in construction materials and associated environmental considerations: A review
9. Celeiro 2020 Chemosphere Evaluation of chemicals of environmental concern in crumb rubber and water leachates from several types of synthetic turf football pitches
10. Preliminary evaluation of the human relevance of respiratory tumors observed in rodents exposed to naphthalene: https://www.sciencedirect.com/science/article/pii/S0273230012000190
11. Perkins 2019 Enviro Res Evaluation of potential carcinogenicity of organic chemicals in synthetic turf crumb rubber
12. https://science.sciencemag.org/content/371/6525/185
13. https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1615
14. https://link.springer.com/article/10.1007/s11356-020-08187-4
15. Halsbrand 2020 Front Environ Sci Car Tire Crumb Rubber: Does Leaching Produce a Toxic Chemical Cocktail in Coastal Marine Systems?
16. Pochron (2017) Chemosphere The response of earthworms (Eisenia fetida) and soil microbes to the crumb rubber material used in artificial turf fields
17. https://en.wikipedia.org/wiki/Amy_Griffin#:~:text=Amy%20Griffin%20(born%20October%2025,deaf%20soccer%20women's%20national%20team.
18. https://edition.cnn.com/2017/01/27/health/artificial-turf-cancer-study-profile/index.html
19. https://www.washingtonpost.com/news/early-lead/wp/2014/10/09/is-there-a-link-between-artificial-turf-and-cancer-in-soccer-goalies/
20. https://www.nbcnews.com/news/investigations/how-safe-artificial-turf-your-child-plays-n220166
21. https://ysph.yale.edu/news-article/health-matters---amy-griffin/
22. https://www.espn.com/espnw/news-commentary/story/_/id/14206717/how-safe-fields-where-play
23. https://www.tangaroablue.org/
24. https://www.ausmap.org/
25. https://researchers.mq.edu.au/en/persons/scott-wilson-2
26. https://www.researchgate.net/publication/344196885_Trends_in_the_management_of_waste_tyres_and_recent_experimental_approaches_in_the_analysis_of_polycyclic_aromatic_hydrocarbons_PAHs_from_rubber_crumbs
27. https://www.sciencedirect.com/science/article/pii/S092134492030001X

TANGAROA BLUE

AUSTRALIAN
MARINE DEBRIS INITIATIVE

AUSMAP
AUSTRALIAN MICROPLASTIC ASSESSMENT PROJECT

www.tangaroablue.org