**Did you know… that every year over a hundred and fifteen billion pages of paper are printed worldwide? No, me neither. Why would you? Apparently if you took all the paper produced in the United States each year you could wallpaper the Grand Canyon… a hundred and seven times!! I dunno why you’d do that, it seems a bit pointless…**

**Anyway, according to this report from the Environmental Paper Network, the world churned through no less than four hundred million tonnes of paper and pulp in twenty eighteen, more than half of which was used for packaging. And I imagine that number probably ticked up ever so slightly during the lockdowns as we all stayed in and ordered all our stuff online.**

**More than half of the world’s paper consumption happens in the USA, China and Japan. Here in Europe, we’re responsible for about another twenty-five percent or so. And just for a bit of context – the entire continent of Africa accounts for about two percent.**

**It takes an awful lot of trees, and water and energy to make all that material from scratch, and none of that consumption is helpful in our current climate emergency, so the very best thing we could all do as individuals is look for ways to absolutely minimise the amount of paper and packaging we generate, and the best thing our local authorities can do is to make sure as much of it as possible is being recycled properly and effectively.**

**According to a European project called Paper Chain, fifty five percent of this continent’s paper and pulp industry waste is simply incinerated, albeit with energy recovery for things like district heating systems. Twenty five percent gets used in land reconstruction and other industrial applications, and fifteen percent currently just gets chucked into landfill. They don’t say what happens to the other five percent, so if you’ve got any clue on that one, let me know.**

**Unsurprisingly, a great deal of research is going on around the world to find ways to use the landfill paper waste in more sustainable ways, and one of the applications being proposed is in the construction of highways. So, could paper roads really become a common feature of our future world?**

**Hello and welcome to Just Have a Think,**

**The European Paperchain project was set up specifically to support and encourage research and development into new ways of utilising waste streams from the European Pulp and Paper industry as valuable feedstocks for three resource hungry industrial sectors, construction, mining and chemical manufacturing, focussing predominantly on that difficult to tackle fifteen percent of waste that currently goes to landfill.**

**And my goodness there are some spectacular names for some of those waste stream by-products. You’ve got green liquor dregs for a start, which sounds like the stuff you used to down during last orders in the student union bar, but which are actually one of the main waste products of the process that converts wood chips into paper in kraft pulp mills. The wood chips are cooked with sodium hydroxide to separate the useful wood fibres from the not so useful lignin, which is the stuff that binds wood together. Along with green liquor dregs, you also get lime slaker grits, lime mud and fibre sludge, all of which get sluiced out of the mill and straight into the ground.**

**And even the paper recycling industry produces ‘De-inking paper sludge’ which, as the name suggests, comes from the industrial process of removing printing ink from paper fibres. Then there’s wastepaper sludge ash, which is what you get left with once you’ve incinerated the sludge.**

**All those waste products are now being put to good use as replacements for existing materials and feedstocks in those key industries, and in the case of road building, it’s the fly ash from the mills that’s of most interest.**

**Over in Spain, a pioneering company called Acciona have been developing sustainable infrastructure solutions, especially in renewable energy, for several decades, and today they’ve got a presence in forty countries with an annual turnover of almost six and a half billion euros. Their latest project is this stretch of highway just outside Valencia. It looks normal enough, but Acciona have been able to replace the cement content of the road sub-structure with that ash from the paper mills. In a recent interview with Euro News, Acciona’s R&D Project Manager, Juan Jose Cepria Pamplona explained**

 **"In road construction, we need the strongest materials. And for that, we usually use cement. This paper ash doesn’t just look like cement. It meets all the technical requirements of cement, but it’s also more environmentally friendly,"**

**"The potential impact of the project is enormous.” He said “We have calculated that we can save 65-75% of the associated CO2 emissions. And by 'scaling up' we could save up to 18,000 tonnes of cement per year.**

**The plan is to use the product all over Spain and then internationally as well, making good use of Acciona’s network of facilities all over the world.**

**Meanwhile, over on the other side of the Atlantic, a team of researchers at the University of British Columbia are working on a set of guidelines that aim to ensure the safe use of these paper industry waste materials in road building.**

**The North American paper and pulp industry produces over a million tonnes of fly ash every year. At the moment the mill owners have to pay to get that waste product sent to landfill and that can cost them anything from twenty five to fifty dollars a ton, so if that liability suddenly turned into an asset, you’re likely to find there’s a great deal of enthusiasm for the idea from within the industry.**

**The BC team, led by associate professor at the university’s School of Engineering, Dr. Sumi Siddiqua, has co-published a paper with postdoctoral research fellow Dr. Chinchu Cherian, investigating the use of paper fly ash, or PFA as it’s known, as an economically**[**sustainable low-carbon binder**](https://www.cdrecycler.com/article/los-angeles-applies-recycled-plastic-asphalt-on-first-major-city-street/)**for road construction.**

**Dr Cherian explained**

**“The porous nature of PFA acts like a gateway for the adhesiveness of the other materials in the cement that enables the overall structure to be stronger and more resilient than materials not made with PFA,”**

**The team carried toxicology analysis on the ash to determine whether any of the nasty by-products from the sodium hydroxide process could leach out into the sub soil beneath the road surface. Their results showed that because the PFA bonds so strongly with the other aggregates, just like a cement, that there was little or no detectable release of chemicals.**

**They also calculated that using PFA as a replacement material was more energy efficient and produced lower carbon emissions. Cement making is a very carbon heavy process, as we discovered in a previous video – and you can click up there somewhere to jump back to that one. So, anything that can reduce the use of cement in construction projects has to be a good thing. And of course, keeping the waste products of paper mills out of landfill isn’t a bad idea either.**

**There’s more research to be done to establish a rigorous set of guidelines for any PFA modifications that may be necessary to ensure there’s a consistent industry standard for its content as production ramps up around the world, but Cherian and the BC team are confident that this technology is on the right track.**

**And it might not only be roads that benefit from this previously landfilled waste product either. Germany’s Federal Institute for Materials Research and Testing, known as BAM, are studying the various properties of fly ash as a cement binder concrete in buildings and bridges.**

**Despite a big movement back towards timber framed buildings, as a smart way to sequester carbon for long periods, concrete still remains by far the most widely used building material in the world. Cement is the hydraulic binder in concrete, in other words it’s the agent that reacts with water to make the concrete set. Once it’s set it becomes waterproof and extremely strong in compression, which is what you want for tall buildings. So, it’s not difficult to see why it’s such a compelling material on a practical level. It’s just a shame it’s so bloody awful from a climate point of view.**

**The BAM team’s research showed that although paper ash has a similar chemical composition to cement, it’s a little less reactive, so they carried out experiments to add a secondary process to activate it before it gets used as the concrete binder. That process involved mixing the ash with water and heating it in a pressure vessel. Then it was burned at seven hundred and fifty degrees Celsius in a process called calcination. The result of their tests showed that the end product behaved exactly like a traditional construction grade cement, which means it can be certified for use in concrete for all sorts of construction projects from residential buildings to industrial plants and road bridges.**

**Getting any significant material changes accepted by the ultra-conservative building industry is always something of a minor miracle, so there will most likely need to be some pretty slick marketing done by whoever ends up mass producing this cement alternative, but if they can penetrate that market then the climate and environmental benefits could be huge.**

**These sorts of incremental changes won’t fix the climate emergency all on their own of course, but to paraphrase the strap line of a well know British supermarket chain, every little helps.**

**If you’ve got views on this fledgling technology, then feel free to jump down to the comments section below and leave your thoughts there.**

**That’s it for this week though.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.
See you next week.**