

# Zero Friction Cycling

## Immersive Wax Vs Drip Lubricant contamination and wear modelling

Modelling - abrasive contamination to lubricant ratio's in chain and accompanying wear rates . Drip lubricant Vs Immersive waxing. \*Note - this is a model using assumptive figures, this is not data from a measured test as that is not currently possible. The figures modelled below will be expected to vary wildly based on lubricant choice (wet vs wax drip, and there is a large performance difference between different products regarding how readily they attract and absorb contamination), as well as your cycling type - ie dusty offroad cycling will attract much more contamination much more quick. Cycling in wet conditions brings in a lot of contamination, again even more so offroad in the mud. As such modelling cannot accurately predict what is occurring in your chain personally, this modelling simply gives an indication of what MAY be occurring in your drip lubricant chain with no maintenance, vs Immersive waxing whereby each re lube is doing a chain flush clean maintenance. This is one of the huge inherent advantages of immersive waxing vs drip lubricants. Yes you can bridge the gap to Immersive waxings lower wear rates by performing chain cleaning maintenance - however the frequency of this, and how well this is done (on bike, off bike - full flush clean, meh flush clean etc etc) is EXTREMELY VARIABLE. Lastly, the modelling below is assuming same contamination gathered per interval for a wax chain vs drip lubricant chain, and in reality this will NOT be the case vs wet lubricants. The solid lubricant path of Immersive waxing simply attracts and retains much less contamination vs wet lubricants - ESPECIALLY in offroad cycling. If i was to model IM waxing vs wet lube for gravel / mtb etc - it would be a dire model for the wet drip lubricant, and this is backed by Dry contamination block 2 wear test results for wet vs wax where IM wax is circa 10x lower wear than even top 5 wet drip lubricants tested. It is not even a competition. For a wet lubricant to not become very abrasive and high wear in offroad cycling requires EXTREMELY frequent full solvent flush clean resets after every ride or at worst every re lube.

### Drip lubricant - Contamination Gathering & wear rate model

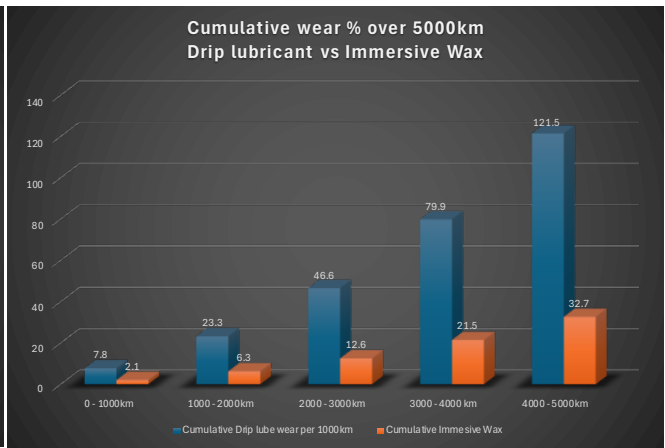
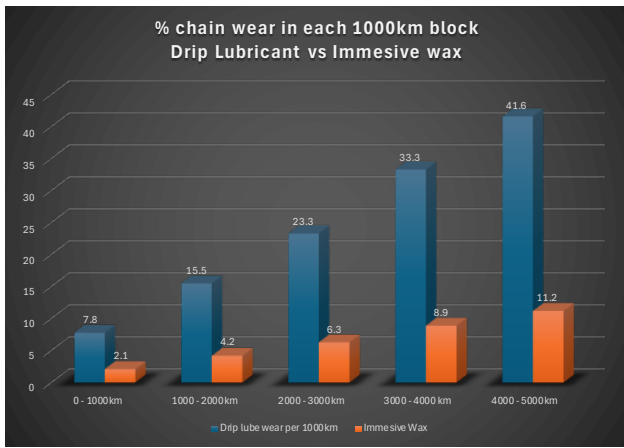
Ride KMs	Contamination Accumulated	Re lube 3ml; Contamination vs Lubricant	Contamination to lubrication	Modelled wear rate	Chain wear this interval	TOTAL CHAIN WEAR (% of 0.5% wear allowance)	chain wear rate averaged (rounded down) per 1000km)
300		0.1 0.1/3	0.033 grams per ml	5% per 1000 km cycling	2%	2%	
600		0.2 0.2/3	0.066 grams per ml	7.5% per 1000km cycling	2%	4%	1st 1000km = 7.8%
900		0.3 0.3/3	0.099 grams per ml	10% per 1000km cycling	3%	7%	
1200		0.4 0.4/3	0.133 grams per ml	12.5% per 1000km cycling	4%	11%	
1500		0.5 0.5/3	0.166 grams per ml	15% per 1000km cycling	5%	15%	1000 to 2000km = 15.5%
1800		0.6 0.6/3	0.2 grams per ml	17.5% per 1000km cycling	5%	20%	
2100		0.7 0.7/3	0.233 grams per ml	20% per 1000km cycling	6%	26%	
2400		0.8 0.8/3	0.266 grams per ml	22.5% per 1000km cycling	7%	33%	2000km to 3000km = 23.3%
2500		0.9 0.9/3	0.3 grams per ml	25% per 1000km cycling	8%	41%	
2800		1 1.0/3	0.33 grams per ml	27.5% per 1000km cycling	8%	49%	
3100		1.1 1.1/3	0.366 grams per ml	30% per 1000 km cycling	9%	58%	3000km to 4000km = 33.3%
3400		1.2 1.2/3	0.4 grams per ml	32.5% per 1000km cycling	10%	68%	
3700		1.3 1.3/3	0.433 grams per ml	35% per 1000km cycling	11%	78%	
4000		1.4 1.4/3	0.466 grams per ml	37.5% per 1000km cycling	11%	89%	
4300		1.5 1.5/3	0.5 grams per ml	40% per 1000km cycling	12%	101%	4000 to 5000km = 41.6%
4600		1.6 1.6/3	0.53 grams per ml	42.5% per 1000km cycling	13%	114%	
4900		1.7 1.7/3	0.566 grams per ml	45% per 1000km cycling	14%	128%	

### Immersive wax - Contamination Gathering and wear rate model

\*Assumption - starting with 500ml of wax, and removing 5ml of wax per re wax

Ride KMs	Contamination Accumulated	Re -wax - adding 0.1 gram Cont, removing 5ml wax	Contamination to lubrication	Modelled wear rate	TOTAL CHAIN WEAR (% of 0.5% wear allowance)	chain wear rate averaged (rounded down) per 1000km)
300		0.1 0.1/500	0.0002 grams per ml			
600		0.1 0.2/495	0.0004 grams per ml		2.1%	1st 1000km = 2.1%
900		0.1 0.3/490	0.0006 grams per ml			
1200		0.1 0.4/485	0.0008 grams per ml			
1500		0.1 0.5 / 480	0.001 grams per ml		6.3%	1000 to 2000km = 4.2%
1800		0.1 0.6/475	0.0013 grams per ml			
2100		0.1 0.7/470	0.0015 grams per ml			
2400		0.1 0.8/465	0.0017 grams per ml		12.6%	2000km to 3000km = 6.3%
2500		0.1 0.9/460	0.0020 grams per ml			
2800		0.1 1.0/455	0.0022 grams per ml			
3100		0.1 1.1/450	0.0024 grams per ml			
3400		0.1 1.2/445	0.0027 grams per ml		21.5%	3000km to 4000km = 8.9%
3700		0.1 1.3/440	0.003 grams per ml			
4000		0.1 1.4/435	0.0032 grams per ml			
4300		0.1 1.5/430	0.0035 grams per ml			
4600		0.1 1.6/425	0.0038 grams per ml			
4900		0.1 1.7/420	0.004 grams per ml		32.7%	4000 to 5000km = 11.2%

The amount of contamination vs lubrication makes is too small to estimate / model and interval wear rate. Chain lifespans on top IM waxes range from typically 10,000km to an astounding 25,000km - depending on cyclists riding, re wax intervals and chain model. Approx 15,000km to recommended replacement mark of 0.5% elongation wear (100% wear) is the general benchmark for good road chains and top tested IM waxes. However, to be EXTREMELY CONSERVATIVE for this modelling, i will use 10,000km lifespan to 100% wear mark, which will put wear at approx 35% by 5000km allowing for some increasing wear rate to be 100% by 10,000km. But you can see for yourself in the numbers of contamination to lubrication why IM waxing will typically deliver much greater than double the lifespan - general 3 to 5x the chain wear lifespan is expected vs average drip lubricant choice



### Combo / Approach - Immersive Wax + Compatible wax drip lubricant.

Many cyclists quickly understand the inherent advantages of immersive waxing for bicycle chain lubrication.

Firstly, it is a solid lubricant and so it has the highest contamination resistance possible.

Secondly every re lube (re-wax) does a brilliant flush clean reset and re lube in one, whereas to contamination reset a drip lube chain to the same level this would require a thorough solvent flush clean bath (or even multiple baths). That is much more mess, faff, cost and disposal headache vs a lovely re wax.

(refer to waxing - concise version - to see just how quick and easy an immersive wax is, it will be easier than you think - <https://www.youtube.com/watch?v=TwXdeOBXIBQ&t=404s>)

However - despite the rapid growth of IM waxing over the last years, re waxing every re lube simply is not practical or preferable to all cyclists.

Hence why the combo / hybrid approach has become very popular.

This is simply start waxed, re lube next circa 5 times with an immersive wax compatible drip lubricant, then re -wax to reset any contamination starting to build I am hoping to control test this method as soon as I can free up a test spot, but in the interim the best guess is that you will get at least 75% of the benefit of immersive waxing all the time, but only doing 1/5th of the time.

This also helps with many who are concerned about master link cost, re-using master links etc. Refer also to the master link guide in this instructions tab on ZFC website.

Currently we only have a small number of officially recommended drip lubricants to use in conjunction with your immersive waxing, and they are;

Silca Super Secret Drip, Ceramic Speed UFO Drip, and Tru-Tension Tungsten all weather. Others are also likely, I have just not had the resources to test.

Such as Cyclowax have a drip lubricant to go with their IM wax, as does Optimize bike, as well as host of other good wax drip lubricants like session components etc, however wax drip performance, possible penetration issues etc does vary a lot, so the official recommended list is small at the moment, but it will grow in time.

Products like squirt, Smooove etc are typical OK, but not the recommended. They use a very different wax base vs the top IM waxes, and over time this may affect the IM wax performance / ability to bond with chain.

However just one or two coatings every now and then (cycling holiday etc) is normally ok, it is just recommend to run that treatment until chain starting to sound dry, there will then be less than 1g of wax left on chain - and then re wax, and all will be fine.

If Immersive waxing or Combo approach sounds like a great idea to you to have the day in day out cleanest, lowest friction and lowest wear chain and drivetrain, for the least amount of time And yes that's correct - Immersive waxing usually SAVES TIME overall vs drip lubricant maintenance, and for much better results;

Head to guides in the ZFC website instructions tab such as Chain prep guide to get waxing, Waxing Zen master guide, as well as on you tube the Zero Friction Cycling video's of **Waxing - Concise version** and for a deeper dive as well as hints and tips - **Waxed Life Like a Boss video**.

### Wet conditions and waxing

If you think waxing / wax drip lubes are not suitable for riding frequently in the wet - that is again another pervasive myth frequently pedalled by - surprisingly, mechanics, tech writes etc who really should know better by now. If someone tells you waxing / wax drip are not suitable for wet weather riding, they simply lack basic knowledge around bicycle chain lubrication - which is actually a unique and extreme lubrication challenge.

The key is unless you get to just hand your bike over after every ride to a bike mechanic to reset your chain, the BEST lubricant path for you in frequently ride in wet conditions conditions is THE EASIEST TO RESET CONTAMINATION post ride. If you don't remove all the crap that wet ride brought deep into your chain and now part of your lubricant, it will be there next ride in the sun, regardless of if you added a few more ml of lubricant over the top of it. If that is all you do, you are literally putting a bandaid on a gunshot wound.

What is the easiest way to re-set a chain post wet conditions riding? Pop it in a wax pot, or fuff with solvents / degreasers? You decide, but - hint - hands down it's the wax pot! A deeper dive on this topic can be found in the Zero Friction Cycling You Tube video **Are Wax lubricants any Good in the wet?**

**Just take note** however that unlike some wet lubes that keep an oily (but consequently abrasive) film over chain, post wet riding IM wax chain or most Wax drip lubricant chains, you cannot just park bike for a day - the chains rollers will start to rust. Simply add a quick coating of compatible wax drip to protect and if necessary - re-lube, until you are able to re wax and re-set chain ready to rock super low friction and wear again.