Bicycle and Motorcycle Chain Oils

Functional Products Inc.

Agenda

- Bike Chain Oils

1. What is a bike chain oil?
   - Purpose
   - Types

2. Advantages and Disadvantages
   - Chain Oil Types
   - Application Methods

3. Formulating Bike Chain Oils

Why Use Bike Chain Oil?

- Bike chain oils are applied to the drive chain of bicycles or motorcycles as part of regular maintenance.

- Bike chain oil is applied for three reasons:
  - Reduce Friction
  - Prevent corrosion
  - Reduce wear

- Ideally bike chain oils increase the life of the chain and gears without causing a build up of dirt and grime

Why Use Bike Chain Oil?

- **Reduce Friction** - increases the efficiency of the bike
  - Easier peddling for bicycles
  - Increased fuel economy for motorcycles
  - Increased performance for both
- **Prevent Corrosion** - protects the chain and gears from rust
  - Extends lifetime of the parts
- **Reduce Wear** - protects the chain and gears from degradation
  - Extends lifetime of the parts

Types of Bike Chain Oil

Three Types of Bike Chain Oil on the Market

1. Dry Lube
2. Wet Lube
3. Ceramic/All-Purpose Lube

Each bike chain oil type can be applied to the chain using one of several application methods.

Application Methods

- Spray Aerosol
  - Common for motorcycles, rare for bicycles
  - Quick, easy application

- Paste
  - Motorcycle
  - Time consuming, brushed on
  - Longer lasting, requires fewer applications

- Liquid/Drip
  - Most common bicycles
  - Dropped on and wiped off or applied with cloth

- Wax
  - Bicycle
  - Rubbed on directly
  - Non-Drip/Low mess

Dry Lube

- Intended for dry conditions
- Low viscosity carrier fluid
  - Quick evaporation leaves protective layer
- Dry layer does not attract dirt
  - Good in dusty conditions
- Easily washed off
  - Not suitable for damp conditions
- Dry, lubricating layer is easily damaged
  - Can require frequent re-application

Wet Lube

- Intended for wet conditions
- Higher viscosity carrier oil
  - Better cling, less wash off
- Stays liquid while on chain
  - Can pick up dirt and grime
- High rust and salt corrosion protection
  - Important for year round riders
- Requires regular changing/degreasing
  - If neglected, accumulated dirt/grime creates black paste

Wet Lube Viscosity

Higher Viscosities:

- Better Water Resistance
- Less Fling Off
- Worse Dirt Accumulation

Viscosity (mm2/s at 40 °C)	Water washout resistance	How often is re-lubing required	Ammount of dirt stuck to the chain
Very high (200)	Very good	Very rarely	Very large
High (100)	Good	Rarely	Large
Medium (40)	Moderate	Moderately	Moderate
Low (15)	Poor	Often	Small

*According to Bikegremlin.com

Ceramic/All-Purpose Lube

- Designed to work in any conditions
- Liquid evaporated to leave tacky layer
  - Not easily damaged or washed away
- Intermediate performance in all conditions
  - Does not require switching lubricants with seasons/weather
- Most expensive, but best overall properties
  - Works in any conditions
  - Will still be outperformed by dry in ideal dry conditions and by wet in very wet conditions

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Oil Type Comparison

	Pros	Cons
Dry Lube	• Repels dirt/dust • Easily cleaned for re-application	• Easily washed off • Easily damaged • Needs frequent application
Wet Lube	• Resists wash off/fling • Resists rust/salt corrosion	• Attracts dirt/grime • Can create black paste • Difficult to clean off
Ceramic/All-Purpose Lube	• Works in wet and dry conditions • Less frequent application	• Less dirt resistance than dry • Less wash off resistance than wet

Application Type Comparison

	Vehicle	Pros	Cons
Spray/ Aerosol	• **Motorcycle** • Bicycle	• Fast and easy to apply	• Messy • Highly Flammable
Paste	• Motorcycle	• Long lasting • Easy to see where applied	• Time consuming • Difficult to apply
Liquid/ Drip	• **Bicycle**	• Relatively quick, easy application	• Messy (Drips)
Wax	• Bicycle	• No Drip • Long lasting	• Flakes off if too much applied

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Bicycle Formulations

- Functional Products formulations are biodegradable
- Competitive with Wet and Ceramic chain lubricants on the market today:

Component	Wet Lube F-346-10B	Ceramic Lube F-346-11B
PAO 4	--	88 %
Technical Soybean Oil	95 %	--
Functional V-508F	2.5 %	--
Functional V-158P2	--	8 %
Functional WA-60SF	1.5 %	--
Functional CI-446EP	--	2 %
Functional PD-585	0.5 %	--
Functional CI-426	0.5 %	1 %
Oleic Acid	--	0.5 %
Functional Ceramax	--	0.5%
KV 40 (D445, cSt)	44.4	35.7
Coefficient of Friction	0.0744	0.0586
Wear Scar (D4172, mm)	0.5	0.55
160 rpm Cling (g)	0.84	0.75

Competitive Comparison

- Easily evaporated carrier fluid leaves behind dry protective layer
  - Often leads to flammability hazards
- Note friction was tested during wear scar tests
  - Harsh conditions likely damaged low friction layer for “B” and “D”

Liquid/Drip Applied Dry Bike Chain Oils

	Competitor “A”	Competitor “B”	Competitor “C”	Competitor “D”	Competitor “E”
KV40 (D445, cSt)	0.9	69.2	32.0	63.0	2.9
KV100 (D445, cSt)	0.71	N/A	2.2	N/A	1.3
Pour Point (D97, C/F)	<-51/-59.8	-9/15.8	-12/10.4	<-51/-59.8	<-51/-59.8
Wear Scar (D4172)	0.55	0.46	0.79	1.74	0.92
Coefficient of Friction	0.128	0.688	0.0491	0.322	0.159
160 rpm Cling (g)	0.64	0.87	0.68	0.5	0.48
Biodegradable	Yes	Yes	Yes	Yes	No
Flammable	Yes	No	No	Yes	Yes

Competitive Comparison

- Higher cling makes Functional wet chain oil less likely to fling off or wash off during riding.
- Both biodegradable and bio-based
- Competitive wear and friction reduction

Liquid/Drip Applied Wet Bike Chain Oils

	Functional Products	Competitor "A"	Competitor "B"	Competitor "C"	Competitor "D"	Competitor "E"
KV40 (D445, cSt)	44.4	93.0	5.1	34.1	25.6	34.3
KV100 (D445, cSt)	10.8	15.3	1.8	8.0	5.0	8.3
VI (D2270)	245	174	--	219	123	231
Pour Point (D97, C/F)	-21/-5.8	-39/-38.2	<-51/-59.8	-36/-32.8	0/32	-15/5
Wear Scar (D4172, mm)	0.5	0.39	0.70	0.44	0.51	0.78
Coefficient of Friction	.0744	0.067	0.102	0.068	0.067	0.051
Weld Load (D2783, kg)	200	200	315	250	126	126
160 rpm Cling (g)	0.84	0.81	0.36	0.64	0.63	0.60
Biodegradable	Yes	No	No	Yes	Yes	Yes
Bio-Based	Yes	No	No	Yes	No	Yes

Competitive Comparison

- Ceramax technology provides balance of wear and friction reduction.
- Biodegradable formulation

Liquid/Drip Applied Ceramic/All-Purpose Bike Chain Oils

	Functional Products	Competitor "A"	Competitor "B"	Competitor "C"
KV40 (D445, cSt)	35.7	52.9	93.5	33
KV100 (D445, cSt)	7.9	8.7	23.6	6.5
VI (D2270)	202	141	282	155
Pour Point (D97, C/F)	<-51/-59.8	-33/-27.4	-24/-11.2	-42/-43.6
Wear Scar (D4172, mm)	0.55	0.43	1.08	0.77
Coefficient of Friction	0.0586	0.069	0.103	0.039
Weld Load (D2783, kg)	160	250	160	200
160 rpm Cling (g)	0.75	0.82	0.74	0.72
Biodegradable	Yes	No	Yes	No
Bio-Based	No	No	No	No

Summary

- Bike chain oils come in 3 types with a variety of delivery methods
  - Dry lubes work best in dry conditions
  - Wet lubes work best in wet conditions
  - Ceramic/all-purpose lubes provide good properties in any conditions

- The most common delivery methods are:
  - Spray/aerosol for motorcycles
  - Liquid/drip applicators for bicycles

- Functional Products can provide bio-degradable formulations that provide friction and wear reduction competitive with todays most popular bicycle lubricants