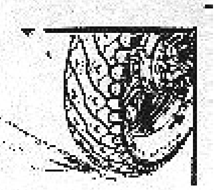


Hydroplaning

"Last week when I was in Denver, I had to rent one of those little econo cars at the airport. Not only did it leak in the rain, but it was so light that coming down an exit ramp it hydroplaned! The rear end almost came completely around! At the time I wished I'd had my Buick. It never did anything like that."

With an air of authority, Frank wiped a little tomato soup from his chin while he waited for me to confirm his distrust of any transportation that weighed less than 3,800 pounds.

I responded, "Usually exit ramps are pretty well designed. Was it flooded or just wet?"

"It was raining pretty hard, but the ramp wasn't flooded. That little car just couldn't handle the rain. In a flood I'd have never made it."

I said, "I'm sure you spun around, but chances are it wasn't because your tires were hydroplaning. If it was simply a matter of weight, you could never ride a motorcycle in the rain. On the contrary, after the oil has washed off the road, cycles do rather well in the rain." By his expression, the tomato soup must have been less tasty than I'd imagined. I continued, "Well, the D.O.T. has done extensive studies on hydroplaning."

"Oh geez, here he goes again," Frank groaned.

"And they developed an equation that will help predict when your tires will actually ride up off the pavement and onto the water."

Never mention something as sacrilegious as "an equation" to someone twice your age who relies heavily on experience and cunning. There's nothing worse than a smart college boy with an equation.

Fortunately, the actual D.O.T. equation is simple enough to figure out in your head. However, there are several other important things to know about hydroplaning before you do any mental gymnastics.

One major misconception is that a heavier vehicle is less likely to hydroplane. Actually, vehicle weight has little to do with it. A loaded Gold Wing or Cadillac is just as likely to hydroplane as a 250cc road bike or a Volkswagon Bug.

Hydroplaning can only occur when the tread of the tire is flooded. This occurs when more water is being introduced than can be dispersed by the tread. Obviously, some tread patterns are more adept than others at water dispersion. While this is nice to know, it's almost useless information since we rarely get comparative data on the different patterns available. Tread *depth* can have as great—and sometimes greater—influence on water dispersion as the pattern. The more worn your tires, the more dry adhesion they are likely to have, but the more likely they are to hydroplane when it's wet.

In recent years some of our highways have had longitudinal cuts, or "rain grooves," made in them. Some cyclists will argue that these cuts were placed there for their personal irritation. However, cutting rain grooves in the highway surface is like increasing the tread depth of your tires—it enhances their ability to disperse water. For someone with balding tires in a rain storm, these cuts could mean the difference between riding normally and sliding horizontally to his or her destination.

Once the tread of the tire is flooded, the amount of air in the tire and the tire's speed will determine whether the tire stays on the road or rides up on the water. For quick reference, if you multiply the tire pressure by two, the result will be the approximate speed at which the tire will come completely off the pavement. For example, if your cycle tire uses 42 pounds of air, you would have to go 84 miles-per-hour before the tire would hydroplane. In addition, since cycle tires tend to be narrower, they are harder to flood because they can disperse water more easily. In contrast, an auto tire is wider (more easily flooded) and often uses less air pressure. Therefore, the auto would tend to leave the pavement and skim on top of the water at a lower speed.

But why don't the rear wheels of a car just lose traction when it hydroplanes, slowing the car down until it regains traction? In extreme cases, this might happen. However, since the front tires have already cleared the road of much of the water, the tread on the back tires have less water to disperse.

This poses a fascinating scenario with rear-wheel-drive cars. As the vehicle proceeds down the road, the front wheels hydroplane and are suspended by the water underneath them. (Look Ma, no steering!) Since the back tires are less flooded, they can keep pushing the car at a high enough speed for the hydroplaning to continue—until you try to turn. Films from D.O.T. tests show front tires that have actually come to a complete standstill at *highway speeds.* Any attempt to turn results in an uncontrollable slide.

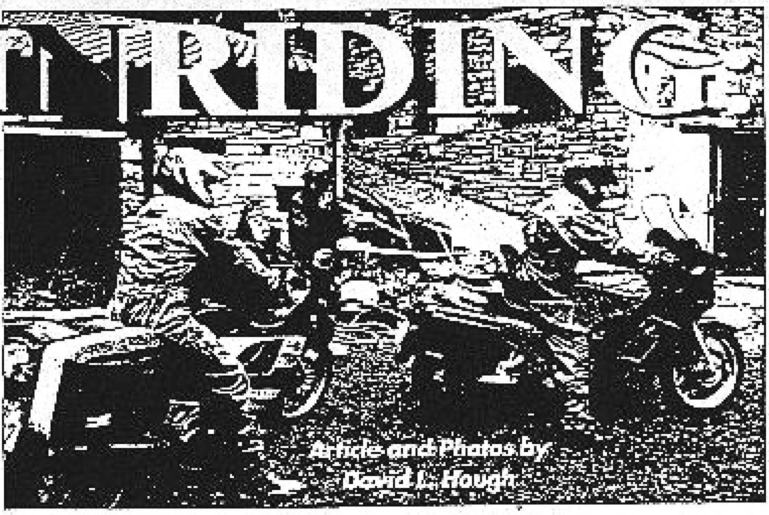
What can you do to prevent hydroplaning? Make sure your tires are properly inflated and have enough tread depth. Theoretically, if you were caught in the rain with worn tires, adding a few extra pounds of air would help keep them on the road. But the best bet is always to wait out the storm. Remember that the D.O.T. equation helps predict the speed at which the tires come completely off the road. Partial hydroplaning, resulting in reduced control, can occur long before that speed.

Because of their higher tire pressures and narrower tire widths (resulting in better water dispersion), motorcycles are much less susceptible to hydroplaning than automobiles. However, this does not mean that motorcycles have more *traction* in the rain than cars. Since most cars have seven to 10 times as much rubber in contact with the road as the average motorcycle, the addition of a film of water still places our two-wheelers at a disadvantage in all but straight-up, straight-line, nonbraking situations. That's something to remember the next time you elect to pass up the last roadside stop when it's raining. I always prefer a warm companion by a glowing fire to a cold, flapping rainsuit out on the road. The road is patient. It will wait. □

About the author: James M. Bavendam is finishing his Ph.D. in Communication Research and teaching at the University of Iowa. His knowledge of riding safety stems from his experiences as a race car driver and teacher of high-performance driving. Bavendam rides a Honda CBX.

RAIN RIDING

Part 1



Article and Photos by David L. Hough

Statistically, the vast majority of motorcycle accidents occur on dry pavement under sunny skies, but that's mostly because the vast majority of riding takes place on warm days. If we commute, or if we tour toward distant horizons, we will encounter rainy days.

Reduced traction, degraded vision and the possibility of hypothermia mean increased risks. Whether we arrive at our destination reasonably comfortable and unscathed, or arrive miserable and possibly wounded, depends greatly upon our knowledge and skill.

Let's consider some of the implications of rain riding. Obviously, the loss of available traction requires much more skillful cornering and braking techniques. With our faceshields spattered with rain and the road soggy wet, we can't see the surface as well, so we've got to predict available traction more by feel than from looking for changes in color or texture as we do on dry days. At night, we're barely able to see where the road is, so the feedback is entirely seat-of-the-pants.

Traction

Clean water on the road surface doesn't reduce traction as much as might think. With today's excellent tire compounds and tread patterns, wet surface traction can be perhaps 80 percent of dry traction on the same surface. What makes the road surface slippery is not just water, but the emulsion of various lubricants with the water. We've heard that oil and water don't mix, but they can certainly get stirred together into a very slippery emulsion, along with a variety of other goop. Cars and trucks drip antifreeze, gear oil, chassis grease, diesel fuel and brake dust. People also drip ice cream, soda pop and french fries just to name a few other lubricants.

This goop doesn't go away; it squishes and soaks into the road surface. Obviously, the longer it has been since a good rain, the more goop there is lurking on the surface.

When it rains, the various goops get rehydrated, the oils float to the surface, and the whole mess gets stirred up by the tires of passing vehicles. Shortly after it starts to rain, we can see the results as streaks of light gray film, beading up of water drops over grease spots, and rainbow hues from floating oil. If it really starts to pour, that's actually better than a misty drizzle, because within the first half-hour of a good downpour, much of the floating oil and goop will get washed off the pavement. Veterans know the advantages of pulling off the road for a break as it starts to rain, not only to don their waterproofs and allow the surface to be washed cleaner, but also to avoid getting crunched by other motorists who might be smashing into each other. Taking a break for dinner also provides some fuel for internal heat to help stave off hypothermia.

Traction between our tires and the road surface is a result of the rubber squeezing around and into the tiny bumps and pockets on the surface of the pavement as the tire rolls along. When lubricants such as water and oil fill the pockets, the rubber has to squeeze through the stuff to get a grip. Oils are too viscous to be quickly squeezed out from under the rubber, and if there is a lot of oil the tire can't get down into the pockets. Diesel oil spills on tight corners such as freeway on-ramps will be almost impossible to negotiate on a two-wheeler.

Fortunately, water is thin enough to squirt out from under the tires very quickly, providing there is an open pathway. Because of the elongated shape of the contact patches, the easiest path is out toward the side of the tire. That's why good rain tires have angled grooves that point out toward the side.

I knew from the pattering of rain on the restaurant window that it was going to be a rough ride tonight. I struggled into my raingear without even looking outside. By the time I had finished dinner a wet front had come pounding in from the coast, and I was a hundred miles and a ferry ride from home. Given a choice, I'd rather not be halfway up a mountain pass at night in the rain. But riding in the rain is one of those certainties that goes with motorcycling. I'd had the enjoyment of a good day's ride, and now it was time to pay the piper.

Hydroplaning

There is a limit to how much water can be squirted out the tire grooves. If there is too great a quantity of water at a given speed, the tire rides up on top of the trapped water, or hydroplanes. Hydroplaning is more of a problem with wider, flatter tires because the water has farther to go toward the sides. Roughly speaking, the typical low-profile radial automobile tire will start to hydroplane in something like a half-inch of standing water at a speed of about 60 mph. Under the same conditions, a typical motorcycle tire would not start to hydroplane until about 70 mph. So, the good news is that, in a heavy downpour, our motorcycles probably have more available traction at highway speeds than the family sedan full of kids in the next lane.

Obviously, while the family sedan might spin out from hydroplaning, it won't fall down. Remember that a two-wheeler uses up some of its available traction just to stay upright. More importantly, greases and oils tend to collect in puddles or strips rather than being spread over wide areas, so it is much easier for a motorcycle to get all of its rubber over a single slippery spot. The moral is, even though a motorcycle might have the potential for greater traction than a car under some circumstances, we must be much more aware of the slippery spots lurking for us.

Slippery spots

The left wheel track may be covered by water but still provide reasonable traction for a motorcycle tire. Near the center of the truck lane, the pavement is not only wet but saturated with a layer of oily sludge. White plastic and painted turn arrows are as slippery as wet ice.

So, a large part of keeping the rubber side down is understanding what is happening on the road surface. It is important to predict where slick spots are likely to be, and then to put our tires over the parts of the surface that offer best traction.

For example, when entering a left-turn lane, we can put our tires just to the right of the left wheel track, but keep them off the center grease strip. If we must cross an edge trap such as streetcar rails, we can cross at maximum angle. In a downpour, veterans put their tires over the patches of pavement that appear to be rougher in texture. They move over to avoid crossing plastic arrows, or shiny painted lane markings. If it is necessary to cross an obvious slippery spot such as a plastic-marked crosswalk or steel construction plate, they momentarily avoid accelerating or braking.

Coming down off the pass tonight, I can barely see where the lanes are. I can't see anything of the surface except shininess. I know that commercial trucks dribble a lot of oil, so I ride in the left wheel tracks, and pass slow trucks, moving as far out of the wheel spray as possible. My adrenaline starts to pump when I feel the tires twitch as I change lanes, but I force myself to maintain speed and hold a gradual arc. I wait to pass in the straights, rather than accelerating in curves where my tires might slip on a pavement break, reflector dot or painted line. I can't afford to waste any traction tonight.

Cornering Lines

At the same speed, a larger radius turn requires less lean angle, and therefore demands less traction. So, on wet pavement it is important to follow cornering lines that make smooth, gradual changes of direction. On a slick roadway, a sudden change in direction or speed can demand more traction than is available. Riders unfamiliar with rain riding may panic when the bike twitches crossing a slick spot, and the survival instinct is to snap off the throttle. Of course, snapping the throttle closed has the same effect as jamming on the rear brake, either of which is likely to cause a slide-out.

Speed

While most veteran riders automatically reduce speed a bit in the rain to stay within the traction envelope, the tactic that really counts is adjusting speed to match conditions. Reduced traction means longer stopping distances, slower cornering speeds and less dramatic evasive action. Even with extra clearance and lights blazing on the rear, the risks of a rear-ender are increased at night. The risks of a rear-ender would be increased by riding slower than traffic flow, so the preferable tactic is to maintain traffic speed and provide more space by increasing following distance to at least four seconds. Every now and then it is worthwhile to count out the seconds, because distances are deceptive at night.

A reduction in speed approaching an intersection is always smart. Slowing even more in the wet helps make up for the loss in braking traction. For example, approaching a busy intersection on dry pavement, an experienced rider may slow from 40 to 30 to cut stopping distance in half. In the rain, that rider may decide to slow down to 25. In the event a car does makes a sudden left turn, the reduced speed allows about the same braking distance as 30 on dry pavement.

Braking

When braking hard in the wet, all of the dry-pavement techniques still apply. It is important to pick the best pavement, stop in a straight line, keep the motorcycle vertical, and apply maximum braking on both wheels just short of a skid. In the rain, the reduced traction will limit how

Entering the big city, the pace and density of traffic picks up. I'm concerned about merging traffic on the superslab. I worry about dropping onto surface streets, about the possibility of cross traffic. Other drivers are just as blinded by smeared windshields and reflections as I am. Before each intersection I take one quick swipe inside my faceshield to improve vision, and slow down more than I would when dry. With double discs up front and a drum on the rear, my machine has a good compromise of systems, but I ride the front brakes slightly to squeegee off the water when approaching potentially dangerous situations such as intersections.

much front brake can be used. Less front brake means less weight transfer to the front, so the rear brake is more useful than on dry pavement. The danger remains that sliding the rear tire can lead to a disastrous high side flip if the rear end slides out and then hooks up with the road again. What all this means is that decreased traction means more equal front-back brake pressure, and longer stopping distances.

Disc brakes have become the standard in recent years because of their power and fade resistance in dry conditions, but riders in wetter climates often prefer drum brakes because of their superior wet weather characteristics. A good drum brake can remain reasonably effective even in a downpour, so brake application with drums is usually very progressive and predictable. Disk brakes are typically more powerful when dry, but less predictable when wet. And the stainless steel discs used on most motorcycles for appearance reasons have less wet friction than the uglier cast iron rotors used in automobiles.

A wet disk brake may produce very little effect when first applied, and then suddenly grab a second or two later when the disk and pads finally squeeze the water out. The instant grabbing can slide the front tire. Different brake systems have different wet weather characteristics, and it is important to understand what the brakes on your particular machine will do in the rain. Even anti-skid or interlocked disc brake systems can have this wet-weather delay.

Pools

At night, the surface of water reflects light the same whether a half-inch deep or six feet deep. Riding into a pool of water just a few inches deep at speed will decelerate the motorcycle so quickly it is difficult to maintain control. Even in shallow water, the wave thrown up by the wheels may get sucked into the intake system, or drown the electrics. In deeper pools, even at slow speeds, water ingested into the engine can cause it to literally blow apart.

There is a lot of water on the highway tonight. I can't see how deep it is, but there are some tactics to help keep me from splashdown in one of those freeway lakes that form in underpasses when the storm drains can't handle the volume of water. So long as I can see the tops of the plastic buttons and reflectors on the road surface, I know the water is less than a half-inch deep. I watch for the reflection of red lights on tunnel walls, indicating something strange is going on beyond my line of vision. And I move to the outside lane of blind curves to gain a little altitude, just in case there is a pool around the corner.

Some drier areas of the country have washes, or crossings where the road dips into what is usually a dry riverbed. If the river ran year-round there would be a bridge, but it isn't practical to build a bridge for a river that only runs once every year or so. The problem for touring riders from wetter areas of the world is that we don't expect the river to suddenly come roaring across the highway when the sky overhead is blue. We may not realize that those thunder clouds 20 miles away are dumping millions of gallons of water on parched desert earth that can't soak it up. Experienced desert riders understand the importance of not zipping over a hill into a dry wash, especially at night.

When you do happen to encounter a flooded wash, don't be foolish enough to attempt riding through it. The flash flood may be roaring across the landscape at speeds in excess of the double nickel at helmet visor depth, and there may be a deep hole underwater where the pavement used to be.

Tires

The traction you will have available when you encounter rain will depend to a great extent on the tires you leave home with. Tires with deep angular grooves in the tread have a much better chance of maintaining a grip on the road. Because water is squirted primarily sideways from under the tire, grooves or channels running across the tread are better than ribs running around the circumference of the tire.

For example, compare the Metzeler Lazer, Bridgestone Supersport, or Michelin A89X to the old ribbed tires that used to come on yesteryear's bikes.

Rounding a shinycorner at superslab speed, my machine felt skittish, as if my tires were approaching the limit of traction. Think about this: a semi-bald tire has more rubber on the road but less wet traction. Why? Because my worn rear tire can't shed water like a new one.

Rain riding is another reason to keep our tires pumped up to pressure. We want to keep the weight pushing the tread blocks down to the surface, without trapping water inside a squishy bulge rippling around the bottom. An underinflated tire is more likely to hydroplane than one with correct pressure.

(continued next month)

The final leg of my ride tonight is on a twisty secondary highway through the forest. My faceshield constantly threatens to fog up, so I must ride with it partially open, and take the stinging rain in my face. There are no street lights to help illuminate the black night, and the fog lines along the pavement are worn so thin that it is difficult to see where the road ends and the trees begin. The darkness and degraded vision conspire to make it difficult to keep the motorcycle within my lane in curves. The occasional headlights of oncoming traffic blaze across the shiny pavement, momentarily overpowering any view of the black road ahead. I protect my critical center-eye vision by the old trick of focusing on the fog line or the reflector posts along the right side of the highway, allowing my peripheral vision to soak up the shock of oncoming headlights. I am thankful that there are few other vehicles on the road tonight and that the deer are smart enough to stay away from the highway. In spite of leathers and a wool sweater under the raingear, the cold water is starting to suck the heat out of my body. "In all my years of riding," I mutter to myself, "tonight's miserable ride has to be the most dangerous and uncomfortable situation I've allowed myself to get caught in."

RAIN RIDING

Statistically, most motorcycle accidents take place on dry pavement under sunny skies. Then again, most riding takes place on warm sunny days. If we commute or tour we will eventually encounter rainy days, so let us consider some of the many implications of riding in the rain.

TRACTION: Clean water on the road's surface doesn't reduce traction as much as we think. With today's compounds and tread patterns, traction can be as much as 80% of what is available on the same surface when dry. What makes the surface slippery is the emulsions of various lubricants that mix with the water. Drippings from vehicles like oil, anti-freeze, grease and diesel fuel all get stirred up in the mix. Then we can add our personal favorites like ice cream, pop/beer and french fries. All these ingredients mix together, and float to the top resulting in very slippery conditions for a M/C or vehicle. Veterans know the advantage of pulling off the road for a break or to don rainsuits when it first starts to rain, which allows the rain to "wash" the highway.

A large part of keeping the rubber side down is understanding what is happening on the roads' surface. The rubber squeezes around and into the tiny bumps and pockets on the pavement. Water is thin enough to squirt out from under the tire quickly, provided there is an opening. Because of the elongated shape of the contact patch, the easiest way out is towards the sides of the tire. Good rain tires have angled groves that point out toward the sidewall. Ribbed or warn tires are prone to ride up on the surface of the water creating an effect known as hydroplaning.

SLIPPERY SPOTS: It is important to predict where the slippery spots are to minimize their danger. White plastic crosswalks and painted turn arrows are as slippery as ice. In a downpour, seasoned riders will put their tires over patches of pavement that appear rougher in texture thus improving traction. At night, the surface of water reflects the same whether the puddle is 1 inch deep or 1 foot deep. Riding into water only a few inches deep can decelerate a motorcycle so quickly that maintaining control can be difficult at best. Use extreme caution when riding in the rain after dark.

SPEED: Most of us automatically reduce our speed in the rain to stay within the traction envelope. Reduced traction means longer stopping distances, slower cornering speeds and less dramatic evasive actions (counter-steering). The risk of being rear ended increases if the rider is traveling at speeds considerably less than the traffic flow, so stay up with the flow but increase your following distance to compensate.

BRAKING: When braking hard in the wet, all of the dry pavement braking techniques still apply. Pick the best pavement, stop in straight line while keeping the motorcycle vertical. Apply maximum braking to both wheels just short of a skid. Since the front brake will be applied slightly less, there will be less weight transfer forward thus making the rear tire more effective. A word of caution...the danger remains that sliding the rear tire can lead to a disastrous high side flip if the rear end slides out and then suddenly regains traction with the pavement.

THE BIKE: Although disk brakes are in wide use and generally considered superior for their dry weather stopping ability, their performance when wet can be less than predictable. Road grime, dirt and oil become imbedded in the rotors. (If you don't believe this, take a cotton ball soaked with rubbing alcohol and wipe it across the rotor.) The first rain that hits the disk brings this oil residue to the surface and, like the road surface, it has to be washed off. A wet disk may produce very little effect when first applied, then suddenly grab a second later as the pads squeeze and wipe the surface of the disk. This instant grabbing can slide the front tire. Since each bike reacts differently take the time to learn how your bike will react under similar circumstances.

Thanks to David L. Hough, from Motorcycle Consumer News for providing the basis for this article.

Ride safe,

RAIN RIDING

TRACTION

80% When DRY
GREASE, FUEL, OIL
POP, BEER, FRENCH FRIES
BREAK FOR JUNK FOOD
LET RAIN WASH ROAD

SPEED

Reduced TRACTION
LONGER STOPPING
SLOWER CORNERING
LESS SWERVING

SLIPPERY SPOTS

White PLASTIC ARROWS
CROSSWALK MARKINGS
R.R. TRACKS
DEEP PUDDLES

BRAKING

Keep VERTICAL
BEST PAVEMENT
LESS ON FRONT BRAKE
HIGH SIDE FLIP

MOTORCYCLE

TREAD DEPTH & DESIGN
DETERMINE HYDROPLANING
Speed = 2 × TIRE PRESSURE