Anti-Lock Braking System in Two Wheelers

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Abstract: In today’s world safety plays a very important role in the field of automobiles. Everybody wants to feel safe whether in their own vehicle or in the vehicle of others. With the introduction of new faster vehicles and two wheeler, accidents are increasing year by year so newer and better safety systems are coming up to prevent accidents or injury to occupants. The ABS (Antilock Braking System) is one such safety feature. Working of the ABS is it prevents the wheels of the vehicle from locking up while braking which causes the vehicle to skid at high speeds. Skidding occurs more in two wheelers as people tend to enjoy to speed up on a two wheeler as it is lighter and gives less aerodynamic resistance. In order to reduce the skidding and improve safety we are planning to introduce ABS in two wheelers. This paper develops the anti-lock braking control system integrated with active suspensions applied to a two wheeler. In emergency, although the braking distance can be reduced by the control torque, the braking time and distance can be further improved if the normal force generated from active suspension systems is considered simultaneously. Finally the future developments on the ABS are dwelt on.

Key words: Skidding occurs more in two wheelers as people tend to enjoy to speed up on a two wheeler as it is lighter and gives less aerodynamic resistance.

INTRODUCTION

Owing to advanced development of vehicular technology, the requirement of safety for automobiles becomes more and more important. Various researchers have considered a slip-ratio control of anti-lock braking systems in the use of sliding mode control schemes. When a driver of a vehicle hits a conventional brake hard that is during panic braking, the wheels may lock causing the vehicle to skid, especially on wet and slippery roads. Antilock brake systems provide the capability for shorter stopping distances and the ability to steer and to maintain control during hard braking, especially on wet and slippery surfaces. This system allows the driver to achieve the two main braking advantages during maximum braking stops, one better lateral stability control may be achieved by automatically pumping the rear brake.

This prevents continuous rear wheel lock-up which is one cause of rear-end skidding and second shorter stopping distances may be generally achieved by automatically providing the average rear brake pressure necessary for maximum stopping force. However, the extent of the wheel lock control brake system advantages is determined by factors such as Road surfaces, weather conditions, driver proficiency, vehicle speed, tire tread wear, tire inflation brakes and suspension components.

Advantages:

- ABS system can provide shorter controlled stopping distances in hazardous condition such as on wet and slippery roads, than most drivers can achieve without an ABS system by providing optimum braking pressure at each wheel.
- It enhances steer ability, allowing the driver to steer the vehicle in the desired direction during braking.
- Brakes are most effective at slowing the car at a point just before wheel lock up, a system that provides for wheel braking while preventing wheel lock up is very desirable [1].

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Antilock Braking System in Two Wheelers: As two wheelers are more unstable in comparison with four wheelers so there are more chances in bikes of getting skid on slippery roads or there are chances of an accident during panic braking. This can be avoided if the similar technology of antilock braking system used in cars is used in bikes. To achieve above in bikes, main aim is to reduce brake fluid pressure inside disc brake calliper in the situation when the bike is just going to skid (after applying brakes), as the pressure is reduced wheels will start rotating & just after a few milliseconds the pressure is increased thereby locking the wheels. This action of increasing & decreasing pressure will respectively stop & rotate the wheels referring to Figure 2. This will built the necessary traction or grip between wheels & road thereby giving the rider a steering control & thus saving an accident. Therefore ABS can prove as a life saving guard.

Working of the Abs in Two Wheelers

For working of ABS we will consider two cases,

Case 1: This case is regarding normal braking operation of bike that is when there is no skid of bike. When brake lever is pressed, the fluid pressure inside the hose pipe connecting master cylinder with brake calliper through solenoid valve increases to about 8 bars. The pressure so produced is enough to bring friction pads of disc brake in contact with rotating disc thus stopping the bike. During this process sensors continuously send their output signals to micro controller. Micro controller checks for the condition of skidding that is whether rpm1 is equal to rpm2 or rpm1 is less than rpm2. As this case is of normal braking operation rpm1 will be equal to rpm2 hence it does not give any output signal. Due to this solenoid valve & solenoid actuator remains OFF.

Case 2: In this case the actual working of ABS system takes place. As we know the rpm sensed by front & rear wheel sensors are continuously supplied to micro controller. Now if found that rpm1 is lesser than rpm2 which is the condition for skidding of bike then micro controller will first trigger the relay which is connected to solenoid valve. Soon after few milliseconds second relay connected to solenoid actuator gets triggered. As soon as first relay gets triggered current flows from battery to solenoid actuator. Due to this solenoid valve gets energized disconnecting hydraulic connection between master cylinder & brake calliper & makes hydraulic connection between brake calliper & injection cylinder. After a delay of few seconds that is after triggering first relay, second relay gets triggered thus energizing solenoid actuator the solenoid actuator would pull master cylinder piston thus sucking in the fluid [2].

The expansion caused in the line will decrease the brake fluid pressure. This is turn would give some motion to the locked wheel. Soon after microcontroller switch Offs the second relay thereby disconnecting the supply from battery to solenoid actuator. Solenoid actuator will no more have power to hold the shaft & thus due to spring action shaft which is connected with piston of master cylinder will move towards left thereby increasing
the pressure of fluid thus locking the wheels. Thus this increase & decrease in pressure will built enough traction between wheels & roads. This traction will help the driver to take bike to safer position. This process are repeated till micro controller finds the condition rpm1 equal to rpm2. As soon as this condition is encountered microcontroller will first switch OFF solenoid actuator & then solenoid valve thus bringing everything into normal state.

Controller: The controller is a computer in the car. It increase & decrease in pressure will built enough traction watches the speed sensors and controls the valves.

How Do They Work?:

- Inside the wheel sensor is a permanent magnet around which a coil is wound.
- This is a magnetic pickup that reads the teeth on the tone ring.
- As each tooth passes under the sensor, it changes the magnetic field.
- This movement, or change, creates a single-direction current in the coil windings inside the sensor.
- After the tooth passes, the field returns to normal.
- This also creates a current in the wire coil but in the opposite direction.
- This results in an alternating current pattern or voltage signal.

Constructional Details of Abs in Two Wheelers:

![New Combined ABS](image)

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**Fabrication**: The first step is to replace the original front wheel drum brake by disc brake kit. The next step consists of fabricating and assembling various components of the hydraulic circuit like single acting cylinder, 3/2 valve, solenoid actuator, threaded rod, spring, sensor holder, battery stand, hoses etc. A m.s. flat will be cut to the required length and then welded with the m.s. flat which will be fastened to the solenoid linear actuator. Thus the frame structure will be formed. The sub assembly consisting of frame, single acting cylinder, solenoid actuator, threaded rod will then be mounted on to the chassis of the bike to ensure whether it fits properly. After ensuring that the sub assembly is fitting properly then we will disassemble it, fit spring, nut and locknut to it and then mount the assembly again on to the bike. The 3/2 solenoid valve holder is made from M.S flat by bending it to the required shape & drilling two holes in it. The holder is then fitted on to the chassis through one of the holes & 3/2 solenoid valve is then mounted on it through the second hole using nut bolts. The main hose line is cut in to two halves & their ends are to be connected to the normally open ports of 3/2 solenoid valve through hose connectors. The third port will be connected to the auxiliary hose which connects the single

**Valves**

- In position one, the valve is open; pressure from the master cylinder is passed right through to the brake.
- In position two, the valve blocks the line, isolating that brake from the master cylinder. This prevents the pressure from rising further should the driver push the brake pedal harder.
- In position three, the valve releases some of the pressure from the brake.

**Pump**

Since the valve is able to release pressure from the brakes, there has to be some way to put that pressure back. That is what the pump does; when a valve reduces the pressure in a line, the pump is there to get the pressure back up.

**Speedsensors**

The anti-lock braking system needs some way of knowing when a wheel is about to lock up. The speed sensors, which are located at each wheel, provide this information.

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acting cylinder. The sensor holders are made from M.S flat by bending it to the required shape & drilling two holes in it. The holders are then to be fitted on to the front & rear fork. Then sensors are fitted on it.

![Fabrication Diagram]

**Oil or Fluid Used in the Antilock Brake System:** Brake fluid is a type of hydraulic fluid used in hydraulic brake applications in automobiles, motorcycles, light trucks and some advanced bicycles. It is used to transfer force under pressure from where it is created through hydraulic lines to the braking mechanism near the wheels. It works because liquids are not appreciably compressible - in their natural state the component molecules do not have internal voids and the molecules pack together well, so bulk forces are directly transferred to trying to compress the fluid's chemical bonds.

Most brake fluids used today are glycol-ether based, but mineral oil (Citroën liquid hydraulique mineral LHM) and silicone (DOT 5) based fluids are also available. Brake fluids must meet certain requirements as defined by various standards set by organizations such as the SAE, or local government equivalents. Their classifications broadly reflect the concerns addressed by the SAE’s specifications. Many countries defer explicitly to the SAE specifications, or simply refer to "best practice" which in practice would defer to the SAE. Brake fluids must have certain characteristics and meet certain quality standards for the braking system to work properly [3].

**Boiling Point:** Brake fluid is subjected to very high temperatures, especially in the wheel cylinders of drum brakes and disk brake callipers. It must have a high boiling point to avoid vaporizing in the lines. This vaporization is a problem because vapor is compressible and negates hydraulic fluid transfer of braking force.

**Viscosity:** For reliable, consistent brake system operation, brake fluid must maintain a constant viscosity under a wide range of temperatures, including extreme cold. This is especially important in systems with an anti-lock braking system (ABS), traction control and stability control.

**Corrosion:** Brakes fluids must not corrode the metals used inside components such as callipers, master cylinders, etc. They must also protect against corrosion as moisture enters the system. Additives (corrosion inhibitors) are added to the base fluid to accomplish this.

**Compressibility:** Brake fluids must maintain low level of compressibility that remains low, even with varying temperatures.

**Service and Maintenance:** Most automotive professionals agree that glycol-based brake fluid, should be flushed, or changed, every 1-2 years. Many manufacturers also require periodic fluid changes to ensure reliability and safety. Once installed, moisture diffuses into the fluid through brake hoses and rubber seals and, eventually, the fluid will have to be replaced when the water content becomes too high. Electronic testers and test strips are commercially available to measure moisture content. The corrosion inhibitors also degrade over time. New fluid should always be stored in a sealed container to avoid moisture intrusion.

DOT 5 is silicone fluid and the above does not apply. Ideally, silicone fluid should be used only to fill non-ABS systems that have not been previously filled with glycol based fluid. Any system that has used glycol based fluid will contain moisture, glycol fluid disperses the moisture throughout the system and contains corrosion inhibitors. Silicone fluid does not allow moisture to enter the system, but does not disperse any that is already there either. A system filled from dry with silicone fluid, does not require the fluid to be changed at intervals, only when the system has been disturbed for a component repair or renewal.

Brake fluid is not considered a "top up" fluid. If it is low, there is usually a problem. Brake fluid level in the master cylinder will drop as the linings (pads or shoes) wear and the callipers or wheel cylinders extend further to compensate. This added fluid may need to be removed when renewing pads or shoes. Overspill from pushing back pistons should be avoided, because glycol based fluid will quickly lift or strip paints and other coatings on contact (it can be removed by quickly washing with water, not wiping). Brake fluid level may also be low because of
a leak, which could result in a loss of hydraulic pressure and consequently, a significant loss of braking ability. Modern cars have split hydraulic circuits to ensure against total hydraulic failure. Brake fluids with different DOT ratings should not be mixed, not all DOT fluid is compatible. This is because it will dilute and reduce the properties of the higher specification DOT fluid, or in the case of mixing of glycol with silicone fluid may cause corrosion due to trapped moisture. Brake fluid can be dangerous as it is toxic and highly flammable.

Components:
Glycol-based (DOT 3, 4, 5.1)
- Alkyl ester
- Aliphatic amine
- Diethylene glycol
- Diethylene glycol monoethyl ether
- Diethylene glycol monomethyl ether
- Dimethyl dipropylene glycol
- Polyethylene glycol monobutyl ether
- Polyethylene glycol monomethyl ether
- Polysyethylene oxide
- Triethylene glycol monobutyl ether
- Triethylene glycol monoethyl ether
- Triethylene glycol monomethyl ether

Silicone-Based (DOT 5):
- Di-2-ethylhexyl sebacate
- Dimethyl polysiloxane
- Tributyl phosphate

ABS (anti-lock braking systems) provides for fast braking response times, especially in stop and go traffic.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Braking Condition</th>
<th>Without ABS</th>
<th>With ABS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Brake applied to the front wheel</td>
<td>29.77</td>
<td>28.29</td>
</tr>
<tr>
<td>2.</td>
<td>Brake applied to the rear wheel</td>
<td>92.02</td>
<td>98.53</td>
</tr>
<tr>
<td>3.</td>
<td>Brake applied to both wheels</td>
<td>30.71 (Front)</td>
<td>32.73 (Front)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.27 (Rear)</td>
<td>7.91 (Rear)</td>
</tr>
</tbody>
</table>

**CONCLUSION**

It be concluded that the bike will be fitted with the ABS system and thus further enhancing the safety of the bike. In successful application of the project the skidding and accident affects in the bike will be reduced hence creating better safety and longer life for the riders. It reduces the worries in people as they will know that there is less chances of them getting hurt in accidents.

**REFERENCES**