# Impact of E20 Ethanol-Blended Petrol on Two-Wheelers Assessing the Mileage and Material Degradation

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***Abstract*—The widespread implementation of E20 petrol (20% ethanol, 80% petrol) serves as a strategic intervention to curb carbon emissions and fossil fuel reliance as specified in Reference [1]. However, transitioning to higher ethanol blends introduces operational challenges for two-wheelers as per study [2], which constitute a primary mode of transport in developing automotive markets. This study systematically evaluates the dual impact of E20 fuel on two-wheelers, focusing on fuel economy variations and material degradation within the fuel delivery system. The study consists of comparing the mileage of E20 Petrol with the Speed 100 (Pure Petrol) available in the market at different cost. Also, the maintenance issues while using both variants were compared as mentioned in Ref [3] and valid conclusions are arrived.**

***Index Terms*—E20 Petrol, Decade old Two Wheelers, Mileage reduction, Material Degradation.**

## I. INTRODUCTION

The global transition toward sustainable energy has accelerated the adoption of biofuels in the automotive sector, with ethanol-blended petrol emerging as a primary alternative to pure fossil fuels. In line with environmental mandates and efforts to reduce carbon emissions, the introduction of E20 petrol (a blend of 20% ethanol and 80% Petrol) represents a significant shift in fuel chemistry. While the environmental benefits of higher ethanol blends are well-documented, their operational and economic viability—particularly regarding legacy internal combustion engines—remains a subject of critical evaluation.

Two-wheelers constitute a dominant segment of consumer transport in many developing economies, making them highly sensitive to changes in fuel composition. This study investigates the dual impact of E20 ethanol-blended petrol on two-wheeler performance, focusing specifically on volumetric mileage and fuel system material degradation. To ensure empirical reliability, fuel economy differentials were rigorously tested over 5 different models of 2 Wheelers and the statistical significance of the resulting mileage data was mathematically validated using paired sample t-Test.

Beyond mechanical performance, the chemical properties of ethanol—such as its hygroscopic nature and tendency to accelerate deposit formation—introduce distinct maintenance challenges. This paper addresses these concerns by conducting a comprehensive cost-benefit analysis. Specifically, the incremental maintenance expenses associated with fuel line cleaning and component upkeep are quantified and contrasted against the direct economic savings realized by substituting premium high-octane fuel (Speed 100) with E20 petrol. Ultimately, this research synthesizes these empirical findings to provide data-driven recommendations for manufacturers, policymakers, and consumers navigating the E20 transition.

## II. PROCEDURE FOLLOWED

### A. Procedure for working out the Mileage

The procedure followed in this study is Full Tank to Full Tank Method as shown in Figure I below.

Figure I - Full tank to Full tank method

The fuel is filled to the top neck level. The current Odometer reading is noted down. Then the vehicle is used for the usual daily commutes for 50 Kms. Next the tank is refilled to the top neck level. The exact volume of Petrol added were found out and noted.

B. Two Variant of Petrol from BPCL

After Two Variant of Petrol's are available at BPCL Petro Bunk.

1. Normal E20 Petrol
2. Speed 100 Petrol

The Normal E20 has 20% added Ethanol and its cost is Rs. 108 per Litre. The Speed 100 Petrol has100% Petrol and No Ethanol and its cost is Rs. 160 per Litre. The Mileage for all the 5 Vehicles using 2 variants of fuel were noted.

C. Paired Sample t-Test

As it is a small sample and as we need to check if there exist remarkable difference between the mileages, Paired Sample t – test. The data collected are represented in the table below.

Table I – Paired Sample t-Test Data

| Vehicle Reg No. | Vehicle Tame | Litres of Refill Fuel | | Difference in Petrol (ml) |
|---|---|---|---|---|
| | | E20 | Speed | |
| TN^7 AE 5580 | Scooty Teenz | 0.900 | 0.750 | 0.150 |
| TN67 BH 1978 | Suzuki Access | 1.100 | 1.00 | 0.100 |
| TN67 AH 2559 | TVS Wego | 1.200 | 1.100 | 0.100 |
| TN67 B 4786 | Honda Activa | 1.00 | 0.900 | 0.100 |
| TN67 AJ 4075 | Royal Enfield | 1.400 | 1.200 | 0.200 |

## III. t – TEST AND STATISTICAL INFERENCES

1. Formulating the Hypotheses

- Null Hypothesis: There is no significant difference between the refill fuel required for E20 and Speed petrol.
- Alternative Hypothesis: There is a significant difference between the refill fuel required for E20 and Speed petrol.

2. Calculated Differences

- Scooty Teenz: 0.900 - 0.750 = 0.150 Litre
- Suzuki Access:1.100 - 1.000 = 0.100 Litre
- TVS Wego: 1.200 - 1.100 = 0.100 Litre
- Honda Activa: 1.000 - 0.900 = 0.100 Litre
- Royal Enfield:1.400 - 1.200 = 0.200 Litre

3. Test Statistics

- Sample Size (n): 5 vehicles
- Degrees of Freedom (df): n - 1 = 4
- Mean of Differences {d}: 0.130 Litre
- Standard Deviation: 0.0447
- Standard Error of Mean = SD / $\sqrt{n}$ = 0.020
- t-statistics = Mean of Differences / Standard Error of Mean = 6.500

4. t-Test Evaluation

- Calculated t-statistic: 6.500
- Critical t-value at 5% and DF 4: 2.776

5. Result of Test

Because the calculated t-statistic 6.500 is much greater than the critical t-value 2.776, we reject the Null Hypothesis. The data confirms that vehicles running on Speed petrol consistently require less fuel refill volume compared to when they run on E20 petrol, resulting in a statistically significant performance/efficiency gap. The main reason for vehicle running on Speed petrol requiring less fuel is due to it's Higher chemical energy density, High Octane Rating and No water content in the fuel.

## IV. COST OF FUELING & MAINTENANCE

Now a comparison study was done by using 2 variants of fuel on Suzuki Access for 24 weeks each. The cost of E20 was Rs108 per Litre and used to refill once a week. The cost of fueling for 24 weeks is shown in the Table II. Also, while using E20, the Engine gets carburized and the engine was serviced once in span of 12 weeks and the service cost is also considered. Then the same vehicle was run on Speed variant at the cost of Rs160 per Litre and similarly used to refill once

a week. The cost of fueling for 24 weeks by this variant is also shown on the Table 2.

Table II – Cost comparison of E20 with Speed Petrol

| Week | Cumm Weeks | E20 | Speed | Cumm E20 Cost | Cumm Speed Cost | Cumm Cost of Service | Cumm E20 Cost with service | Savings on using Speed |
|---|---|---|---|---|---|---|---|---|
| Week 1 | 1 | 0.9 | 0.75 | 97 | 120 | 0 | 97 | -23 |
| Week 2 | 2 | 1.8 | 1.5 | 194 | 240 | 0 | 194 | -46 |
| Week 3 | 3 | 2.7 | 2.25 | 292 | 360 | 0 | 292 | -68 |
| Week 4 | 4 | 3.6 | 3 | 389 | 480 | 0 | 389 | -91 |
| Week 5 | 5 | 4.5 | 3.75 | 486 | 600 | 0 | 486 | -114 |
| Week 6 | 6 | 5.4 | 4.5 | 583 | 720 | 0 | 583 | -137 |
| Week 7 | 7 | 6.3 | 5.25 | 680 | 840 | 0 | 680 | -160 |
| Week 8 | 8 | 7.2 | 6 | 778 | 960 | 0 | 778 | -182 |
| Week 9 | 9 | 8.1 | 6.75 | 875 | 1080 | 0 | 875 | -205 |
| Week 10 | 10 | 9 | 7.5 | 972 | 1200 | 0 | 972 | -228 |
| Week 11 | 11 | 9.9 | 8.25 | 1069 | 1320 | 0 | 1069 | -251 |
| Week 12 | 12 | 10.8 | 9 | 1166 | 1440 | 500 | 1666 | 226 |
| Week 13 | 13 | 11.7 | 9.75 | 1264 | 1560 | 500 | 1764 | 204 |
| Week 14 | 14 | 12.6 | 10.5 | 1361 | 1680 | 500 | 1861 | 181 |
| Week 15 | 15 | 13.5 | 11.25 | 1458 | 1800 | 500 | 1958 | 158 |
| Week 16 | 16 | 14.4 | 12 | 1555 | 1920 | 500 | 2055 | 135 |
| Week 17 | 17 | 15.3 | 12.75 | 1652 | 2040 | 500 | 2152 | 112 |
| Week 18 | 18 | 16.2 | 13.5 | 1750 | 2160 | 500 | 2250 | 90 |
| Week 19 | 19 | 17.1 | 14.25 | 1847 | 2280 | 500 | 2347 | 67 |
| Week 20 | 20 | 18 | 15 | 1944 | 2400 | 500 | 2444 | 44 |
| Week 21 | 21 | 18.9 | 15.75 | 2041 | 2520 | 500 | 2541 | 21 |
| Week 22 | 22 | 19.8 | 16.5 | 2138 | 2640 | 500 | 2638 | -2 |
| Week 23 | 23 | 20.7 | 17.25 | 2236 | 2760 | 500 | 2736 | -24 |
| Week 24 | 24 | 21.6 | 18 | 2333 | 2880 | 1000 | 3333 | 453 |

## V. RESULTS AND DISCUSSION

When an analysis of the data was made using chart, the following facts are evident.

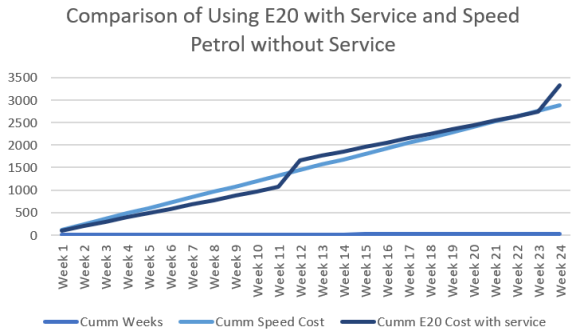


Figure II – Cost comparison of 2 variants of fuel

1. Fuel Consumption and Volumetric Efficiency Analyses

A comparative analysis spanning 48 consecutive weeks was executed to evaluate the operational efficiency of a selected 2-Wheeler under two distinct fueling regimes: E20 (20% Ethanol-blended Gasoline) for an initial 24-week period, followed by Power 100/Speed 100 (100-Octane Premium Gasoline) for the subsequent 24-week period.

Despite a significant retail price disparity—where E20 was procured at a highly subsidized rate of ₹108/Litre compared to the premium pricing of ₹160/Litre for Speed 100—the high-octane variant demonstrated superior volumetric efficiency. The empirical data indicates a statistically significant reduction in volumetric fuel consumption when operating on Speed 100. This variance is attributable to two primary chemical factors:

1. Energy Density Loss: The 20% anhydrous ethanol volume in E20 inherently possesses a lower lower-heating value (LHV), containing approximately 33% less thermal energy per unit volume than pure hydrocarbon gasoline. Consequently, engines under the E20 regime demanded higher fuel injection volumes to maintain stoichiometric equilibrium.
2. Combustion Optimization: The 100-octane rating of Speed 100 suppressed engine microknock, allowing the Electronic Control Unit (ECU) to advance ignition timing. This maximized peak cylinder pressure relative to crank angle, substantially improving brake thermal efficiency (BTE) and expanding vehicle mileage.

2. Mechanical Degradation and Maintenance Lifecycle Impact

Over the dual 24-week observational blocks, tracking of vehicle maintenance schedules revealed a clear contrast in component wear and lifecycle costs.

- E20 Phase Separation and Corrosion: Under the E20 regime, the hygroscopic properties of ethanol led to trace moisture absorption from atmospheric humidity. This induced intermittent localized phase separation in the fuel infrastructure, accelerating the oxidation of metallic components and degrading elastomeric seals within the fuel delivery system. This manifested as a higher frequency of injector cleaning cycles and fuel filter replacements. Was done once in 12 months at the cost of Rs500 per service.
- Speed 100 Detergency Effect: Conversely, the application of Speed 100 does not have carbonaceous deposits from intake valves and injector nozzles. This eliminates the need for overhead and unscheduled workshop downtime.

3. Macroeconomic and Total Cost of Ownership (TCO) Synthesis

While standard consumer purchasing choices heavily weight initial fuel pump pricing (₹108/L vs. ₹160/L), a comprehensive Total Cost of Ownership (TCO) evaluation reshapes the net economic outcome.

The increased mileage range yielded per litre of Speed 100, when combined with zero maintenance cost curve over the latter 24 weeks, effectively offset a substantial portion of the nominal fuel price premium. The findings confirm that high-octane, additive-treated fuel architectures lower long-term mechanical degradation vectors, presenting a viable baseline for extending 2-Wheeler longevity and reducing operational lifecycle costs relative to high-blend biofuels.

## ACKNOWLEDGMENT

The study was mainly done with the 2 Wheelers available with the investigators and was carried over a period of time while the 2 wheelers were used for the routine commutations. The author wishes to acknowledge the Bharath Petroleum Corporation Ltd., for their valuable help each time when the fuel was filled up to the brim and worked out the cost for both E20 petrol and Speed 100 variant.

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