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A4_10 Pokémon: Literal Soul Food

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Abstract

This paper investigates the number of living souls required for the ghost-type candle Pokémon, Litwick, to absorb to sustain the flame atop its head. It was found here that Litwick must consume 4.5×10^{-7} souls every year, or equivalently that it needs to consume one whole soul approximately every 2.2 million years.

Introduction

The expansive world of Pokémon includes over 900 species of Pokémon, all weird and unique in a variety of ways. A lot of the exact science of the Pokémon world, however, is of course questionable, as is the case with such unfortunately fictional worlds.

Litwick (Figure 1, right) is one such interesting species, a small candle-like ghost-type Pokémon with a blue/purple flame on top of its head. Litwick's body, presumably made of wax, never loses mass as its flame burns. According to the Pokédex, Litwick's flame is said to absorb the "life energy", or arguably, "souls", from both people and Pokémon and this becomes the fuel for the flame. [1] The question then is: how often would a Litwick have to absorb a "soul" to sustain its flame?

The biggest issue is how exactly to quantify a "soul". Thankfully, there also exists another ghostly Pokémon, Spiritomb (Figure 1, left), said to be formed from the amalgamation of 108 souls trapped in a stone, referred to as the "Odd Keystone" [1]. Therefore the mass, and then the energy of such a soul in the fictional world can be determined from known information for Spir-

itomb.

Analysis of Dimensions



Figure 1: Litwick and Spiritomb side by side, with heights and relevant dimensions labelled.

According to the vast collection of information on Pokémon available, Litwick's body is 0.30 m tall and Spiritomb measures at 1.00 m tall, weighing in at 108 kg [1]. Based off of measuring Figure 1, created with the 2 Pokémon to scale, Litwick's flame is found to have a height of approximately 0.26 m, and the base of Litwick's head to have a diameter of 0.23 m.

Spiritomb's Odd Keystone also has approximately the same height as Litwick, and with its

slightly trapezoidal shape, we can approximate the rock as a 0.30 m cube, with a volume of 0.027 m³.

Energy of a Soul

$$m_{stone} = \rho V \quad (1)$$

The mass of the Odd Keystone, m_{stone} can be found with Eq.(1), where V is its volume and ρ is its density. Taking the extreme case of the keystone being one of the densest natural rocks, peridotite or gabbro, with a density of 3400 kgm⁻³ [2]. This gives a mass of 91.8 kg. From this and Spiritomb's total mass of 108 kg we can deduce the collection of 108 souls to have a mass of 16.2 kg and therefore the mass of a single soul, m_{soul} to be 0.15 kg.

$$E_{soul} = m_{soul}c^2 \quad (2)$$

The energy of a soul, E_{soul} can then be found using the mass-energy equivalence equation, Eq.(2), where c is the speed of light, giving 1.35×10¹⁶ J.

Energy Usage of the Flame

$$\frac{L}{D} = \gamma Q^n \quad (3)$$

The ratio of flame height, L to burner diameter, D , can be given by Eq.(3) where $\gamma = 3.30$ [3] is a dimensionless constant, Q , is the heat release rate in kW and $n = \frac{2}{3}$ for $Q < 1$ [3].

$$Q = \left(\frac{L}{D\gamma} \right)^{\frac{1}{n}} \quad (4)$$

Rearranging for Q gives Eq.(4). Substituting in the constants mentioned and using $L = 0.26$ m and $D = 0.23$ m gives a value for $Q = 0.19$ kW

$$S = \frac{Q}{E_{soul}} \quad (5)$$

Hence with the energy of a soul, $E_{soul} = 1.35 \times 10^{16}$ J and the energy usage of Litwick's flame, 0.19 kW, it can be with Eq.(5) that the number of souls per second, S , Litwick must

consume to sustain its flame is 1.43×10^{-14} soul s⁻¹. Equivalently, Litwick would need to consume 4.50×10^{-7} soul year⁻¹, or 1 soul every 2.2 million years.

Discussion

These findings mean that thankfully a Litwick need only drain a soul of the living in the Pokémon world once every 2.2 million years. And assuming that Litwicks can drain "life energy" gradually it means that they should be able to drain the required 4.50×10^{-7} souls every year without causing too much of an inconvenience to those it finds surrounding itself. The real issue of course would be if a Litwick decided to absorb more than this willingly as they are known to be mischievous, or arguably just evil depending on your level of compassion for a living candle that knows no better.

Conclusion

In conclusion, a Pokémon Trainer that does somehow manage to successfully capture and befriend a Litwick should need not worry about losing their own life to become fuel for their partner's flame as the energy content of their soul far outweighs the Litwick's needs, and the Litwick could simply wait for their trainer to pass of old age before taking enough "fuel" for the next 2.2 million years. So it turns out a Litwick is no real danger to anybody in theory, *if* they are friendly at least.

References

- [1] <https://www.serebii.net/pokedex-swsh/>[Accessed 26/10/2022]
- [2] <https://jakesnatureblog.com/2016/12/14/heaviest-rock/#> [Accessed 26/10/2022]
- [3] Tong Xu, Peng Lei, Experimental study on flame height and heat release rate estimation of diesel-wetted wood powder fire (2022)[Accessed 26/10/2022]