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What's That Stuff?

Instant Film

Layers of light-sensitive dyes, emulsions, and developers combine in one-step photography

Lisa M. Jarvis


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PERHAPS the allure lies in the instant gratification and tangibility of being able to snap a photo and hold a print immediately in your hand, or maybe it's just the pleasure and nostalgia of watching a fuzzy image in a white plastic frame come into focus. Regardless of the source of its appeal, instant film has had a dedicated following since the Polaroid camera hit the market in 1948.

Yet even cultural icons can fall victim to market economics. Instant film has never been cheap, and few people process film at all these days. Many more snap a picture with their iPhone and within seconds upload it to their Facebook page for hundreds of friends to see. Last year, Polaroid decided to end manufacture of instant film, leaving die-hard fans to hoard it and wonder where their next fix would come from.

According to Polaroid, the idea of a photo lab in a box came to inventor and physicist Edwin Land in 1944, when his daughter asked why she had to wait so long to see a picture taken while vacationing. Over the course of three years, Land figured out how to achieve a one-step photography process.

Despite the inelegance of the subsequent design—insert bulky cartridge into equally bulky camera, press oversized button, yank out film, and patiently (without shaking) wait for image to appear—the process of quickly achieving a color photograph is remarkably easy.

Instant film may seem like a simple product in the package, but it is actually carefully composed of layers of dyes, emulsions, and developers—everything needed to capture the image, develop the film, stop the developing process, and neutralize any unused chemicals.

It uses the same general principles as the roll of color negatives you put in a regular point-and-shoot camera. A standard color negative has three layers of silver bromide crystals, each sensitive to a particular color (blue, green, or red). When film is exposed, a latent image is formed in each silver bromide layer as light reduces Ag^+ ions to Ag.

Instant film contains those same three light-sensitized layers, but below each layer is an oppositely colored hydroquinone-decorated dye. For example, below the blue-sensitive silver bromide layer sits yellow dye, where yellow is the opposite or the "negative" color to blue on the color wheel. Analogously, below the green-sensitive crystals lies magenta dye, and below the red crystals lies cyan dye.

THE IMAGE is formed through a complex, inverse filtering process: The dyes from unexposed layers are allowed to pass up through to the image layer and combine at the surface. For example, if a blue area is exposed, then no yellow dye can pass through but magenta and cyan can, and the mixing of these two colors forms blue.

After exposure, the film is ejected from the camera, passing through a set of rollers that spread developing chemicals across its surface. One of these developing chemicals is potassium hydroxide, which diffuses downward and reacts with all the hydroquinone-decorated dyes. The resulting dye molecules can then diffuse up through the light-sensitive layers wherever their corresponding silver bromide molecules have not been exposed.

The process ends when the potassium hydroxide reaches the timing layer, in which any leftover base is neutralized. Unexposed silver bromide is then dissolved by other components in the developing solution, including potassium thiosulfate and uracil.

The whole ordeal is finished in a minute or so and—voilà—a photograph is born.

Despite Polaroid's move to end manufacture of instant film, the iconic product may get a reprieve. A group of seven scientists, engineers, and businessmen bought the equipment and signed a 10-year lease on Polaroid's factory in Enschede, the Netherlands. The team calls itself "The Impossible Project," and its mission is not to replicate the product but to develop a less expensive version of Polaroid's signature film.

"Polaroid made a great product. It would be a pity if such an easy, simple-to-use product would disappear from the market," says Martin Steinmeijer, The Impossible Project's senior photo-system chemist.

The team faces a lot of challenges, Steinmeijer says. "Getting the right colors is very difficult," he says. "It took years to develop the first instant image." He notes that chemists have to determine just the right amount of silver bromide and developer dyes that go into each layer; find the perfect concentration of chemicals to put into the reagent and negative layers; and ensure that the layers, particularly the timing layer, is the right thickness.

As for Polaroid, the company isn't disappearing along with its iconic film. Rather, it claims to be "reinventing instant photography for the digital age." Last year, the company unveiled Polaroid PoGo, a digital camera that can print a 2- × 3-inch photo with a sticky back, all ready in a mere 60 seconds. Whether the new school can maintain the same allure as the old remains to be seen.