Vacuum University 101

LESSON 4: Industries and Vacuum

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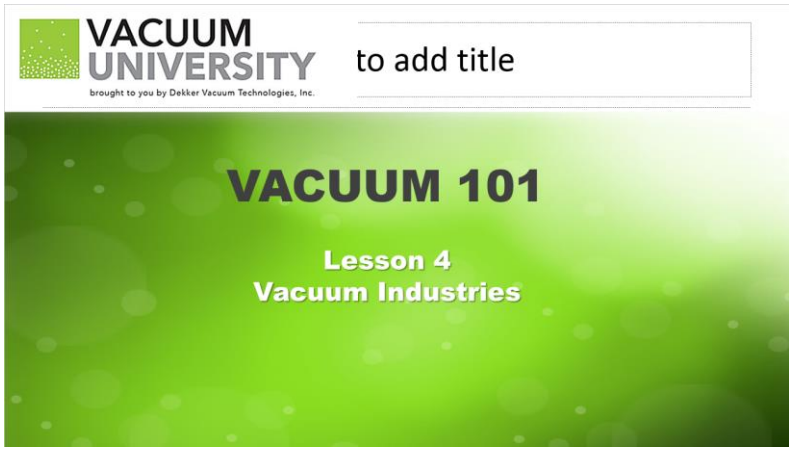
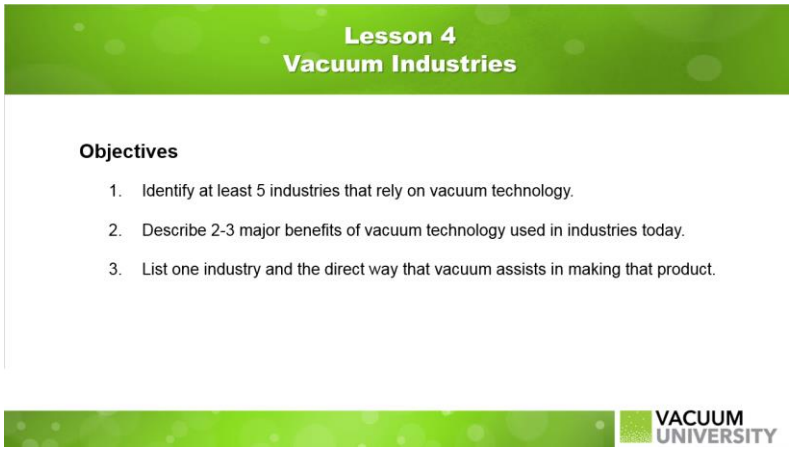
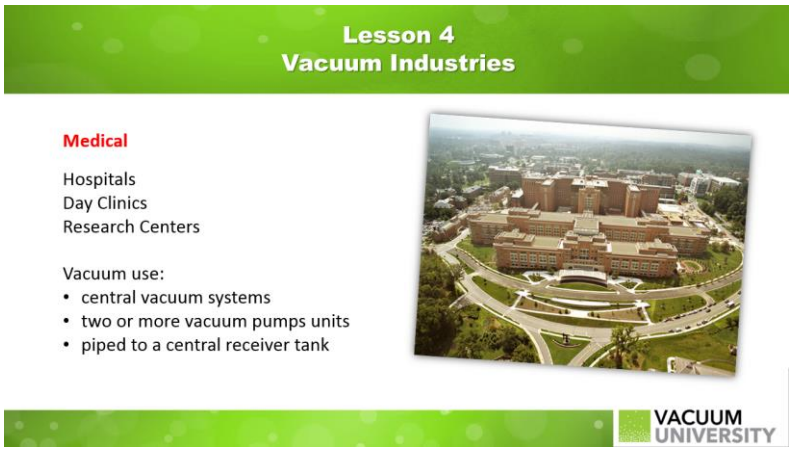
	Welcome to Lesson 4. Vacuum Industries. The capability to create and sustain a vacuum at precise levels is one of the most important processes in industry today. Vacuum technology has hundreds of industrial uses. Vacuum technology makes the manufacturing of thousands of products possible. It's also used to improve the quality of the products being produced, streamline the production process for greater efficiency, or make production more environmentally friendly.
	The objectives for this lesson are as follows: 1. Identify at least 5 industries that rely on vacuum technology. 2. Describe 2-3 major benefits of vacuum technology used in industries today. 3. List one industry and the direct way that vacuum assists in making that product.
	Before going any further in reviewing nine industries and their use of vacuum, it is important to emphasize once again that there are hundreds of industries that utilize vacuum technology. In fact, you would be challenged to find an industry that didn't use some form of vacuum technology to assist in product development. Once again, please refer to the Application/Industry Matrix in Additional Materials section of this site for more information.

Lesson 4 **Vacuum Industries** 1. Beverage 2. Chemical 3. Food 4. Medical 5. Oil and Gas 6. Pharmaceutical 7. Plastics 8. Power 9. Pulp/Paper  VACUUM UNIVERSITY	Let's now focus on nine industries that rely on vacuum to do the job. Beverage, Chemical, Food, Medical, Oil/Gas, Pharmaceutical, Plastics, Power, and Pulp/Paper. Let's go into more detail on each one of these industries and the value that vacuum technology brings to them.
Lesson 4 **Vacuum Industries** 1. Beverage 2. Chemical 3. Food 4. Medical 5. Oil and Gas 6. Pharmaceutical 7. Plastics 8. Power 9. Pulp/Paper  VACUUM UNIVERSITY	**Beverage.** We have all seen pictures of high speed bottle filling machines used in the beverage or associated industries. When filling bottles in a matter of seconds we need to evacuate the air out of the bottle, which is done either by a pre-vacuum cycle or during the filling cycle. The filling takes place when a filler nozzle (compare it with a cork) with two or three tubes comes down on the bottle top the one tube is connected to a vacuum pump and the second tube is the liquid filling tube, the third tube when applicable is for injecting carbon dioxide.
Lesson 4 **Vacuum Industries** **Beverage** Evacuating air out of bottle: • Liquid is injected into bottle • Air is removed by vacuum pump • CO^2 is injected after filling Liquid ring vacuum pumps use water as seal fluid  VACUUM UNIVERSITY	As the liquid is injected to fill the bottle the air is removed at the same time by the vacuum pump. With carbonated beverages like Coca-Cola, CO^2 is injected in the bottle after the filling. When filling bottles with beer and wine we tend to see a lot of foaming, which is a problem for most vacuum pumps except for a liquid ring vacuum pump using water as the seal fluid.

Lesson 4 **Vacuum Industries** 1. Beverage 2. Chemical 3. Food 4. Medical 5. Oil and Gas 6. Pharmaceutical 7. Plastics 8. Power 9. Pulp/Paper  VACUUM UNIVERSITY	**Chemical**. The chemical industry is the one responsible for converting raw materials like water, oil, natural gas, air, metals, and minerals, into more valuable products. Polymers and plastics are used for construction pipes, tools, materials like acrylics, appliances, electronic devices, transportation, toys, games, packing, clothing and textiles like nylon and polyester, among many other products.
Lesson 4 **Vacuum Industries** **Chemical** • Distillation used for refining products and recovering raw materials • Example: Flavors and fragrances • Vacuum Stripping/De-aeration to remove gas from liquid  VACUUM UNIVERSITY	Process applications in the chemical industry using vacuum include distillation which is used to refine a wide range of products and recovering raw materials for reuse. One example is the distillation of flavors and fragrances as these products are temperature sensitive and would be damaged if heated to their normal boiling point. Vacuum Stripping/De-aeration is used to remove gas from a liquid such as the removal of oxygen from seawater lowering the dissolved oxygen content to control corrosion rates and inhibit bacterial growth before secondary injection into oil wells.
Lesson 4 **Vacuum Industries** 1. Beverage 2. Chemical 3. Food 4. Medical 5. Oil and Gas 6. Pharmaceutical 7. Plastics 8. Power 9. Pulp/Paper  VACUUM UNIVERSITY	**Food.** We love eating chicken! In the United States, we eat about 100 pounds of poultry every year, mostly chicken. This industry isn't just chicken feed – it's worth 70 billion dollars a year, employing half a million workers. With the help of vacuum technology, plants can process 100,000 chickens every day. Vacuum technology plays a key role in two of the most important considerations of poultry processing – speed of production and food safety.
	In the late 1940s, engineers developed a process using liquid-ring vacuum pumps to remove and

	dispose of the inedible parts of the poultry. It replaced the manual use of knives and scrapers with a more sanitary, high-speed process. The vacuum system worked so well that it became an industry standard in other types of meat processing. Vacuum is even being used to make chicken taste better. Chicken parts are placed in an autoclave under vacuum, into which a marinating solution has been added. The vacuum causes the pores in the meat to expand and fill with marinade. It's much quicker and more thorough than just letting the product soak.
	**Medical**. The main users of vacuum in this industry are Hospitals and Day Clinics and special research institutes like the National Institute of Health. The application is for central vacuum systems consisting of two or more vacuum pumps units piped to a central receiver tank, including electrical controls for complete automatic operation. These systems are normally installed in the basement of the buildings together with other mechanical equipment, like compressors and Hvac systems. The systems are connected to a central piping system throughout the building to the different sections in the facility.
	The main areas connected to the vacuum system are patient rooms and operating theaters. Each room has one or more outlets in a wall mounted panel, which also includes a connection for oxygen and nitrogen. The vacuum level at each outlet is approximately 10 - 12 " Hg and is hooked up to a glass bottle by a nurse to suck up body fluids and small solids. Although the vacuum level at point of use is 10 - 12" Hg the vacuum pump system in the basement generally operates between 18 - 24" Hg to overcome line losses. Pump sizes depend on the size of the facilities but range from 5 HP for a small facility to as high as 50 HP for a large facility all in Duplex or Triplex arrangements for complete back-up.

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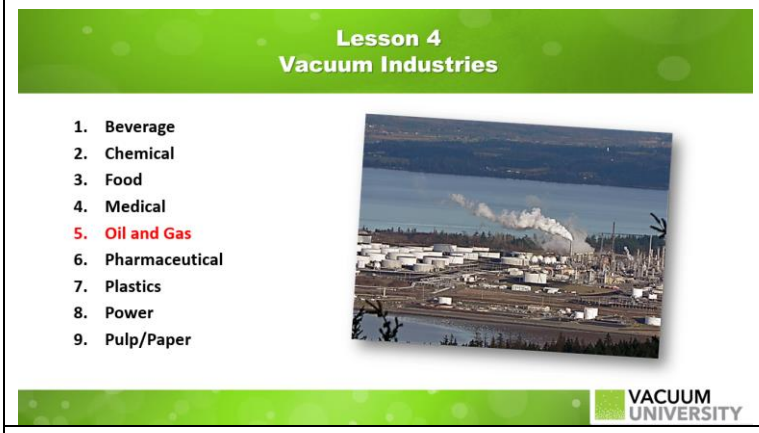
<td> 
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<td>Oil and Gas. Oil Refining starts with heating the crude to approximately 400-600 degrees and is then introduced into the crude oil tower as a liquid/vapor where different fractions including Gasoline, Kerosene, and Diesel fuel are separated and removed. The heavier liquid component fractions fall to the bottom of the tower and this material requires further processing to obtain its useful products. The next step in the refining process is to fractionate or separate the heavier liquid component in a vacuum distillation tower.</td>
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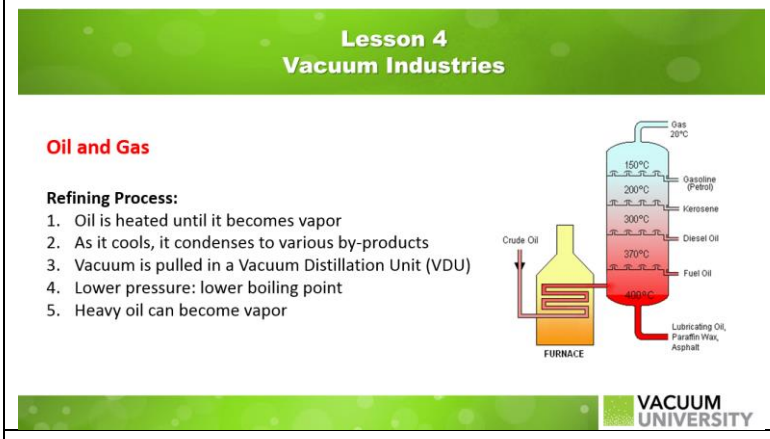
<td> 
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<td>Normally the heavier liquid fractions would have to be heated from 700 degrees to more than 1000 degrees to reach their normal boiling points and be successfully separated, however at these elevated temperatures the product will be damaged or destroyed so lowering the pressure in the tower, which lowers the boiling points of the fractions is required to safely separate and remove these products.</td>
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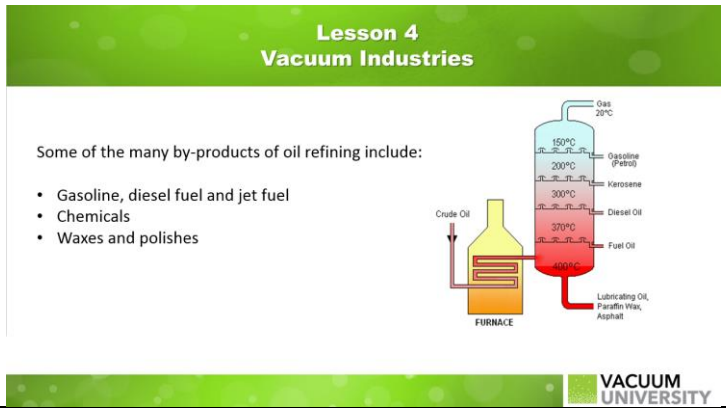
<td> 
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<td>Useful products removed from the vacuum distillation tower include, from the top of the tower, lighter fractions that are removed and sent to the catalytic cracking unit for further processing into gasoline, diesel and jet fuel, then waxes and lubricating oils from the middle of the tower are removed, and finally asphalt and industrial fuel oils from the bottom of the tower.</td>
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<td>Pharmaceutical. The pharmaceutical industries are substantial users of mainly integrated engineered vacuum pump systems. The main application is for vacuum drying together with solvent recovery.

Considering all the special drugs produced by these companies such as Pfizer, Merck, Novartis, Eli Lilly, Johnson & Johnson and Biotech companies. Most of these drugs are produced from a mixture of propriety</td>
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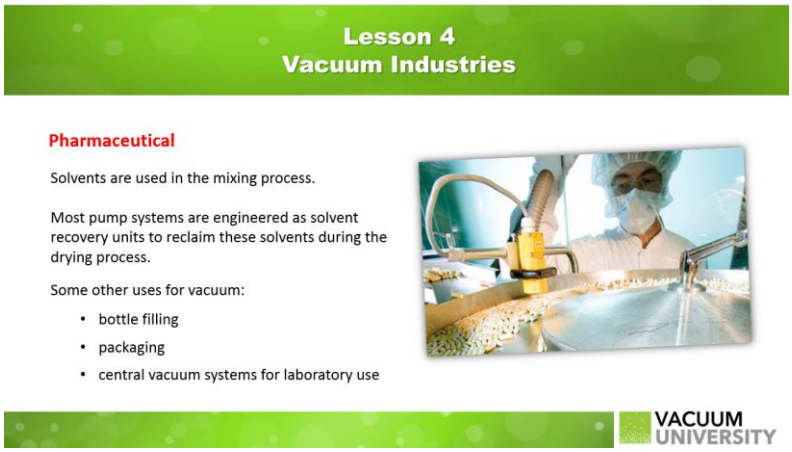
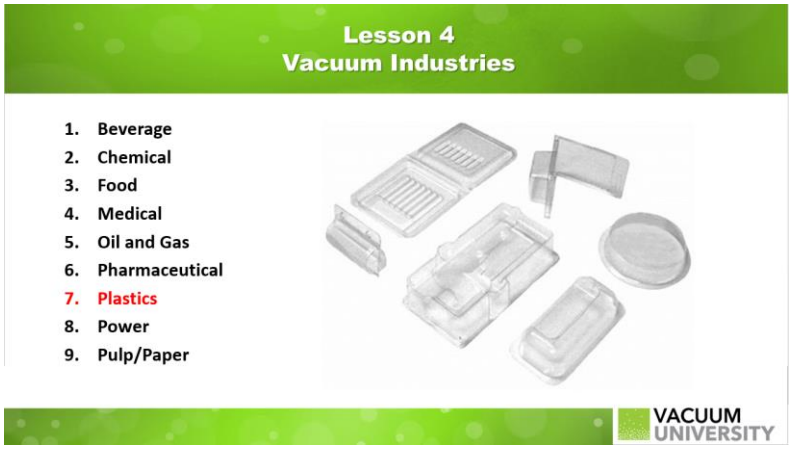
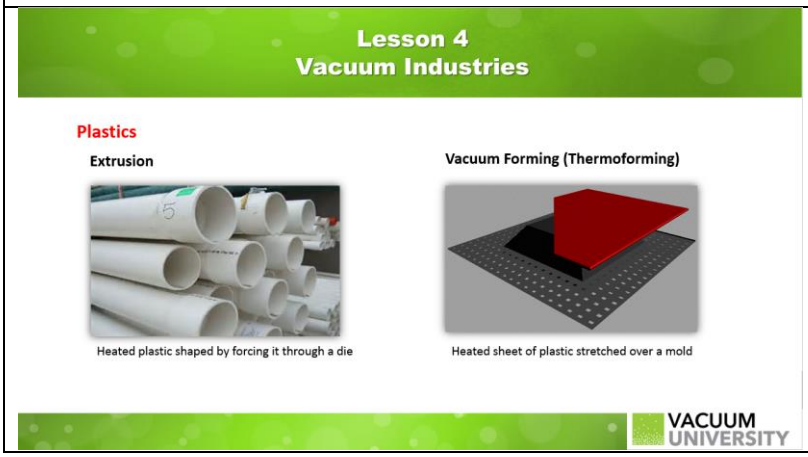
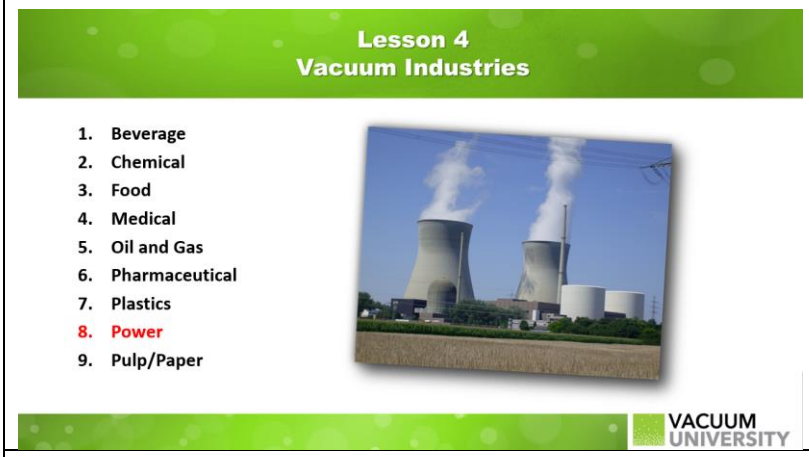
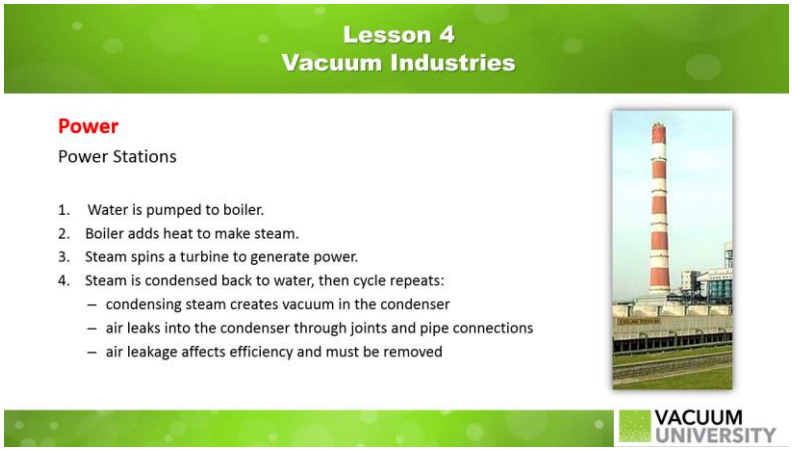
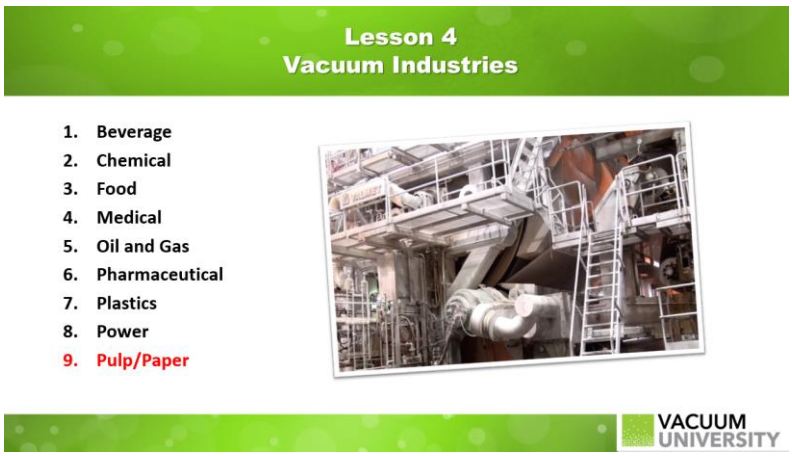
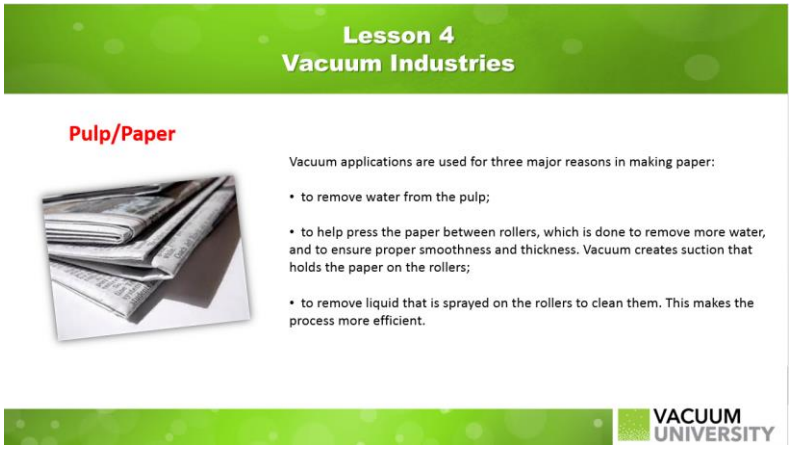
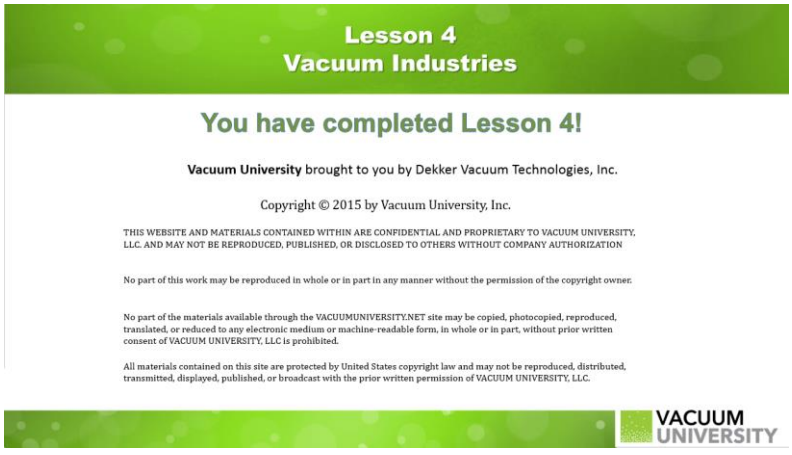
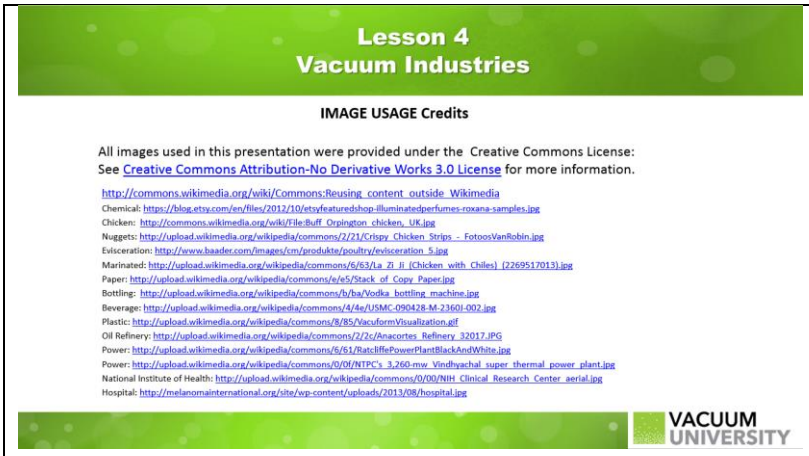
	ingredients and mixed together with certain solvents in a mixer / reactor to form a slurry resulting in a homogenous product. High vacuum in the range of 1 - 10 Torr is required because the process needs to be at low temperature to prevent product damage.
	Since solvents are used in the mixing process most pump systems are engineered as solvent recovery units to reclaim these solvents during the drying process. Recovery is achieved by using inlet and discharge condensers, which are cooled by chilled water. For purity most of these systems are manufactured with all wetted parts in stainless steel. Some other uses for vacuum in these industries are bottle filling and packaging and central vacuum systems for laboratory use.
	**Plastics.** If there's one thing that is abundantly useful in our lives today, it's plastic. It seems that almost anything can be made of the stuff. Many plastic products, such as siding, pvc tubing and garden hoses, are manufactured through the process of extrusion, in which heated plastic is shaped by forcing it through a die.
	A second plastic manufacturing process is vacuum forming, or thermoforming, in which a heated sheet of plastic is stretched over a mold. A large variety of plastic products, from disposable cups to bath tubs and automobile body parts, are vacuum formed. Vacuum is used extensively in both applications.

	**Power.** Today, we power our lives with the flip of the switch. Light, heat, coolness, security, energy, all at our fingertips almost anywhere at any time.
	In order to help the process of creating this power from thermal power stations there are several steps that are followed. First, water is pumped into a boiler. Next, the boiler adds heat in order to make steam. Steam then spins a turbine to generate power. The fourth stage is that steam is condensed back to water and the cycle repeats itself. Where vacuum comes into play is when this steam is condensed. This creates a natural vacuum in the condenser. Because of this vacuum, air will leak into the condenser. If the air is not removed, it will cause the condenser to lose performance. Vacuum pumps are used to remove this air in-leakage.
	**Pulp/ Paper.** Consider the hundreds of everyday uses for paper products. From the most delicate tissue to the strongest corrugated cardboard, paper is produced in many thicknesses and weights, for books, magazines, printer paper, paper towels, paper plates, boxes, plasterboard, filters, lampshades, bandages, even money. Paper begins as pulp that is two percent paper fiber and 98 percent water. When it completes its course through the paper machine, the product is 98 percent paper and two percent water.

	Throughout the paper production process, vacuum applications are used for three major reasons: • to remove water from the pulp; • to help press the paper between rollers, which is done to remove more water, and to ensure proper smoothness and thickness. Vacuum creates suction that holds the paper on the rollers; • to remove liquid that is sprayed on the rollers to clean them. This makes the process more efficient.
	To review, there are many industries that utilize vacuum technologies. Some of the few that we reviewed during this lesson were the industries of beverage, chemical, food, medical, oil and gas, pharmaceutical, plastics, power, and finally pulp/paper.
	Congratulations on completing the 4th and final lesson for Vacuum 101. Congratulations on completing the first course of Vacuum University brought to you by Dekker Vacuum Technologies, Inc.



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