TEXAS TECH UNIVERSITY CENTENNIAL

Spring 2023 NEWSLETTER

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Chairs Welcome

This year has proven to be very exciting around the department as we started off by raising the derrick on our fully operational drilling rig in January. We also had 100% job placement and the average salary of $104,000 a year. New research has been really kicking into high gear around the department as well. We have adapted coursework to incorporate energy transition subject matter such as offering a carbon capture and storage certificate which was just approved and will be available to students graduating in May 2024. Our goal is always to make our students more marketable and we believe that this is key in that endeavor.

I would invite you to go to our department website to see TV footage of raising the rig over Red Raider well number 3. The direct video link is https://www.youtube.com/watch?v=dYVFaOXlpcA . That was a very special day. I would like to give a big thanks to Denny Bullard who persevered through it all to make this historic event happen. We still lack the top drive and circulation system hookups, but we are hopeful that can be completed by early Fall. As most of you probably know, the oilfield is a very busy place, and the Texas Tech petroleum engineering department is not exactly a high priority of oilfield service companies.

One of the major challenges from upper administration is to increase our enrollment. Currently, our enrollment is around 150 students from freshman through senior year. In addition,

we have about 50 graduate students. This is no different from all the other petroleum engineering departments across the U.S. Other than the 2013-14 boom, we have maintained a ranking of the fifth or sixth largest undergraduate program. In the boom, we were the largest department in the world, but only had eight faculty. Currently, we have 11 full time and one part-time instructor. We recently raised $4 million dollars for an endowed chair that we have named after Dr. Winkler. We are actively looking for someone to hire for this position. We are also looking for replacement faculty for the two who recently retired.

I am very encouraged by the number of students and their parents that I have met with over the summer at Red Raider orientation. The first day students are here, we give them a tour around the department and give a presentation on the oil industry, and on the second day, I meet with them to discuss general college expectations and skill sets needed to be successful. The students seem to be very engaged and excited about the program, more so than in previous years. This past spring during our petroleum industry advisory board meeting, a campaign was kicked off to raise a $2 million endowment to offer scholarships to all students including first-year students. When enrollment started falling back in 2017, I started traveling to several community colleges across Texas to build a relationship and forge agreements to make it easy to transfer into our program. Currently, those agreements are in the Dean's office working through various legal aspects. The basic concept is for students to be dually enrolled in their community college and Texas Tech so they can begin coursework in petroleum engineering during their sophomore year.

The other mandate from the administration is to increase our research expenditures. We have been working very hard to establish ourselves in the areas of carbon capture utilization and storage (CCUS), produced water, hydrogen creation and storage, wellbore integrity, and artificial lift. Several of these will be expanded upon in this newsletter. On my visit to Washington D.C. in the spring of 2022, I met with many different congressional committees on energy and technology. I also met with Dr. Sally Benson, who is the president's Deputy Director for Energy, Office of Science and Technology Policy at the White House. The excerpt from the slide below was her message to the Petroleum Engineering Department Heads Association (PEDHA) regarding the continuing need for petroleum engineers in conjunction with a long-term strategy of the United States for pathways to net zero greenhouse gas emissions by 2050.

- Pathways to net-zero include CCS (Carbon Capture and Storage) and CDR (Carbon Dioxide Removal)
- Hydrogen is number one way to achieve goal
- Skills and science/engineering capabilities in PE are relevant for many applications
- H2 storage
- CO2 storage
- CS with EOR
- Improved recovery from brownfields
- Solution mining for critical materials
- Geothermal

This is basically the same message I received from all the congressional committees that are focusing primarily on CCUS. In conjunction with our DOE project partnering with the University of Illinois geologic survey, we have filed a patent for legacy well classification for the permitting of EPA Class IV injection Wells. I have also been active as a co-author of the Storage Resource Management System document (SRMS) published by SPE and on various SPE subcommittees for the Carbon Storage Resource Committee.

As everyone is fully aware, we are amid celebrating Texas Tech University's Centennial. The College of Engineering has planned several events in

various Texas cities, two of which have already happened in Dallas and Fort Worth. Other events in Houston, Midland, San Antonio, and Austin are planned for this Fall. Also, our football team won the Texas Bowl in December and coach McGuire is as popular as ever. There is a lot of excitement around Red Raider nation as many think, including players and coaches, that we have a real shot at winning the Big 12. As always, we have the best tailgate on campus next to our building and Terry Fuller's bus. Please come by and meet all our great students and faculty that frequent the tailgate. The first several home games have already announced 6 PM start times. You all know that means there will be a bunch of rowdy Texas Tech fans and a lot of fun, not to mention you will not be baking in the West Texas sun. The first game is on September 9th against Oregon.

This Fall, Texas Tech is also hosting the outspoken fossil fuel advocate Alex Epstein on September 5th at 5:30 PM in the Red Raider Ballroom located in the student union building. The event is being sponsored by Cody Campbell in cooperation between the Law School, Business and Engineering colleges.

TTU Petroleum Engineering – A Look Back

The Department of Petroleum Engineering was established in 1937 as part of the Geology program. Petroleum and Geology were first organized under one department due to the intimate relationship of geology in the work of Petroleum Engineering. At the time, these two programs offered fundamental training in engineering and in geology to prepare students for work in oil companies. In the Fall of 1939, a third option in petroleum production was proposed that would specialize in problems occurring in producing oil from proven fields. By 1938 there were 158 students enrolled in the department.

The department as we know it, as its own autonomous program outside of geology, began in 1946 with the first graduate in 1948. The program was first accredited by ABET in 1958. When the department started, it was housed in wooden barracks until it moved in 1950 to a newly completed building that consisted only of a ground floor. This building was located next to the current Track and Field Stadium. The second story and north wing of the building were completed in 1953. Many years later in 1983, the old Petroleum Engineering building was connected to Chemical Engineering and the Engineering Center through an addition. In 2007, the department was named after Bob. L Herd for his many accomplishments in the industry and his steady and continuing support of the department and Texas Tech University as a whole. In spring 2014, the department moved into the 42,000 square foot $23.8 million Terry Fuller Petroleum Engineering Research Building on the northeast corner of the engineering key. This new building was entirely funded by alumni and industry and contains state-of-the-art equipment and labs.

In 2017, the department completed the first phase of the East Campus Oilfield Technology Center (OTC). Located just 15 minutes away from the main campus, the OTC is a unique educational facility designed to serve both research and teaching needs. Over the last 74 years, the department has been led by eleven chairpersons as follows:

1946 - UNKNOWN
William Ducker, Professor

UNKNOWN - UNKNOWN
Phillip Johnson, Professor, Interim

UNKNOWN - 1971
William Ducker, Professor

1971-76
Herald W. Winkler, Ph.D., P.E.

1976-83
James T. Smith, Ph.D.

1983-89
Robert Carlile Ph.D.

1989-91
Carlon S. Land, Ph.D., Interim

1991-98
John J. Day, Ph.D., P.E.

1998-99
Lloyd R. Heinze, Ph.D., P.E., Interim

1999-2004
James F. Lea, Ph.D., P.E.

2005-2010
Lloyd R. Heinze, Ph.D., P.E.

2011-2012
Mohamed Y. Soliman, Ph.D., P.E.

2013-PRESENT
Marshall C. Watson, Ph.D., P.E.

The program currently houses 11 full-time faculty, many of whom are conducting innovative research, such as carbon capture and utilization storage, advanced drilling technologies, geothermal, well stimulation, and advanced well completion technologies. The department also has one part-time instructor, one technician, and 4 full-time staff.

In total, TTU has produced 3200 B.S Petroleum Engineers or ~ 5% of the total worldwide. In 2023, the Texas Tech Petroleum Engineering program was ranked #9 in graduate (up two spots from 2022) and 6th in undergraduate in the United States per U.S. News and World Report for best Petroleum Engineering programs.

Per our 2023 Spring senior exit survey, 100 percent of our U.S. citizen students were employed by the time they graduated. The average salary upon entering the job market was $104,500, with the highest salary reported at $139,000, not including sign-on bonuses.

This past Spring, we graduated 33 seniors, and our upcoming senior class is currently at 27. Our current summer enrollment numbers are up, however, from Summer 2022. In summer 2022 we had 25 students signed up for Red Raider Orientation, and we currently have 58 signed up for Summer 2023.

Oilfield Technology Center

The Oilfield Technology Center is located on 10 acres of land on the Texas Tech East Campus. This facility is designed to serve as a research and teaching facility to give both undergraduate and graduate petroleum engineering students a hands-on experience in design, safety, and operation of typical oilfield equipment. Texas Tech is the only university in the country with this type of facility. Our students are gaining experiences that are unique to Texas Tech that cannot be found anywhere else.

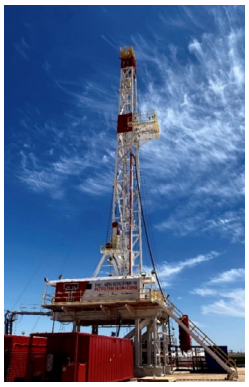
Although primarily designed for use with the petroleum engineering curriculum in mind, the OTC can also be utilized for third-party workforce development training. Testing of new, downhole tools or production-treating processes can also be done utilizing the resources available at the OTC.

The Oilfield Technology Center has a variety of equipment for student and research purposes. The rig itself was raised in January 2023 over Red Raider Well #3. On the premises are also the Red Raider No. 1 well, drilled in 2001 and Red Raider #2 currently targeted for gas lift research. In addition to the two wells, there is a gas treating pad, a working tank battery and a 4,800 square foot building that houses a 45-person classroom, office spaces, restrooms, and a heated workshop display area which provides space for exhibits of cut-away models of large pieces of oilfield equipment.

Each semester the department hosts a Roughneck Boot Camp for current and prospective students.

This camp was created to give an overview of what students can expect in the oil and gas industry. Students not only get a tour of the facility, but also receive specialized professional development with Dr. Marshall Watson, the chair of the department, industry experts, upper-division students, and departmental staff. This includes networking, interviewing skills, and resume critiques.

Donated and funded exclusively by alumni and industry partners, the drilling rig came in pieces in 45 separate truckloads. Initial discussions with Patterson UTI about a drilling rig at OTC began in 2017 and ramped up in 2018. By 2019, the department had drilled two wells to 1,500' with a rig provided by Butch's Rat Hole and Aveda (now Brady's) offered to move the rig from Oklahoma to OTC. In 2020 the mast and rig components were delivered to the OTC location. In 2021 we began the electrical work and set the rig in place, while also working on preventing theft and vandalism of the site. In 2022, preparations to raise the mast began, and on January 6th, 2023, the mast was raised. Construction work continues with finishing up piping and top drive equipment.



We are incredibly grateful for our donors. From the labor, the equipment, and the dollars spent, our Oilfield Technology Center could not exist without the efforts of our alumni and the wonderful support system our department has. We look forward to continuing to produce top-quality students who can utilize our one-of-a-kind facilities and bring their expertise to the petroleum industry.

New CCUS Course, Undergraduate Certificate and Graduate Minor

In July Exxon announced it's $4 B acquisition of Denbury. Exxon said it is purchasing an experienced developer of carbon capture, utilization, and storage (CCUS) solutions and EOR for $89.45 per share, representing a roughly 2% premium compared to Denbury's July 12 closing price of $87.75. Our department is launching a brand-new undergraduate certificate in Carbon Capture Utilization Storage (CCUS). Our current juniors will have the opportunity to graduate with this certificate in May 2024. While we have been teaching CCUS for many years in our curriculum, this certificate allows us to take it a step further and give students the added bonus of a certificate on their degree and resume, making them more marketable.

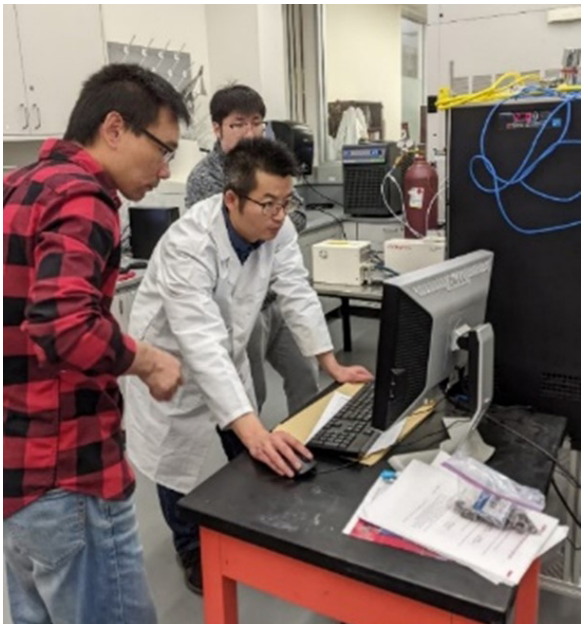
After completing the certificate, students will be able to understand CO2 phase behavior and flow in the subsurface, know how to create sustainable CCUS projects, know more about the physics of CO2 transport, injection, and storage modeling studies, know the practical aspects of CO2 flooding, assess CO2 capacity and containment, and understand Class VI CCUS wells and EPA permitting.

With these new additions to our program, we have created a new class called Geoenergy and Carbon Management. This class will be open to both undergraduate and graduate students and will cover the fundamentals of geoenergy and carbon capture utilization and storage. This covers geothermal, hydrogen generation and storage in formation, carbon capture, carbon storage, and utilization of CO2 (EOR.)

Carbon-Zero Hydrogen Production from Petroleum Reservoirs Using Catalytic Microwave Heating

Dr. Qingwang (Kevin) Yuan and his Ph.D. student Keju Yan are working on generating hydrogen within petroleum reservoirs using catalytic microwave heating. The produced hydrogen will then be extracted to the surface with the help of downhole hydrogen membrane separators. The byproducts such as solid carbon and minor carbon oxides can be simultaneously sequestrated underground.

The proposed technology has the potential to directly generate and produce clean hydrogen from petroleum reservoirs without any CO2 or methane emissions to the atmosphere. By repurposing depleted oil & gas reservoirs and re-using the existing industrial infrastructures, it will provide a new, low-cost, and carbon-zero technology to decarbonize fossil fuels and enhance the value of the assets in the petroleum industry.



Pictured left to right, Dr. Quingwan "Kevin" Yan, Keju Yan, and Baizheng An

The schematic for in-situ hydrogen production from shale gas reservoirs via microwave-assisted catalytic heating. (Sciencedirect.com)

Financial support is from the Matejek Family Faculty Fellowship at Texas Tech University, the CH Foundation, and DOE's Hydrogen Shot Incubator Prize Program. Mr. Keju Yan, a Ph.D. candidate who mainly conducts experimental work, appreciates the support from the Distinguished Graduate Student Assistantship and the Graduate Research Support Award at Texas Tech University.

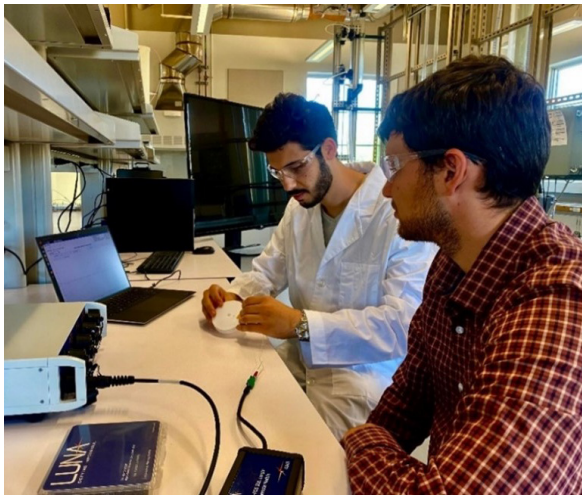
Fiber Optic Sensing to Improve Artificial Lift

Dr. Smith Leggett's lab is utilizing fiber optic sensing technology to gather valuable data on multiphase flow, including strain, temperature, and noise measurements over long extents of pipe. Currently, Dr. Leggett's Ph.D. student Omar Abdelkarim is working on a novel method to track liquid slugs using fiber optic measurements, with the aim of improving intermittent gas lift technologies. The potential impact of this research is immense, as it is expected to lead to new methods for increasing production from unconventional wells.

Omar's work will continue as a part of the Texas Tech Gas Lift Consortium, set to launch in January 2024. This consortium will bring together companies interested in improving the performance of gas-lifted unconventional wells. If you are interested in learning more about the consortium or the research being conducted by Dr. Leggett and his team, you are encouraged to reach out to him at sleggett@ttu.edu.

Methane Detection and Quantification

Methane is deemed to be one of the greenhouse gases responsible for climate change. Detecting methane will help curtail its emission and prevent climate change. Dr. Hossein Emadi and Mr. Denny Bullard are currently working on methane detection research projects. So far, they have received two industry-sponsored projects which address methane detection. They are currently collaborating with the two companies to enhance methane detection techniques and compare the existing technologies with the developing ones. Multiple technologies, including fixed sensors and Optical Gas Imaging (OGI) cameras are being tested and studied at the OTC. The plan is to analyze the generated data to thoroughly evaluate the technologies and make recommendations for future usage depending on the application.

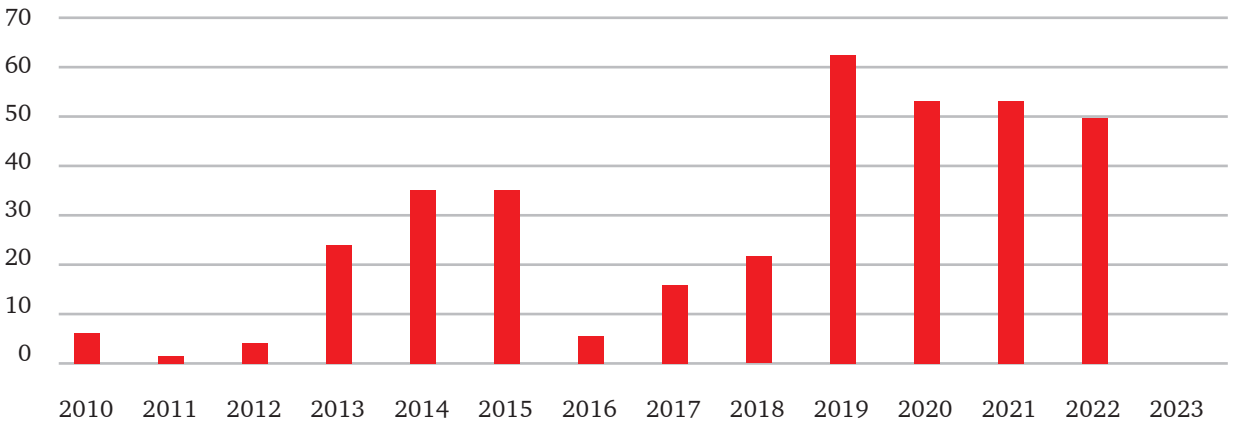


Pictured left to right, Dr. Quingwan "Kevin" Yan, Keju Yan, and Baizheng An

Publications and Faculty Research

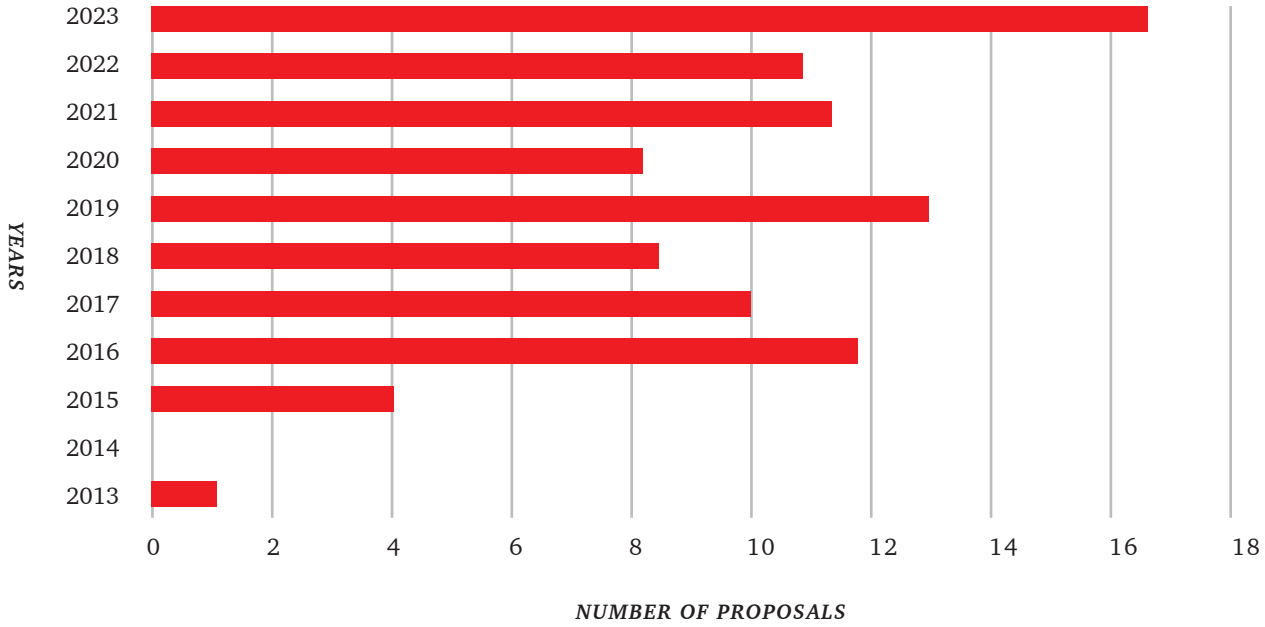
Graphs displaying our awards and publications from 2013 to present.

PUBLICATIONS



FACULTY RESEARCH

Proposals by faculty continue to increase year after year



Alumni Spotlight

CATHY H. NORWOOD earned a B.S in Petroleum Engineering from Texas Tech University and has over 30 years of experience in the oil and gas industry. Since her time at Texas Tech, she has excelled in her career. Cathy works as a Senior Consulting Engineer with Hickman McClaine & Associates, is a licensed professional Engineer in both Texas and New Mexico, is a member of the Society of Petroleum Evaluation Engineers, has served as Chairman of the Midland Chapter, has served on the national Member Benefits Committee, and in 2016 was appointed by Governor Greg Abbott to serve on the Texas Board of Professional Engineers. Cathy was the first Petroleum Engineer to ever serve on the board.

When asked what being the first Petroleum Engineer on the board meant to Cathy, she said

she was shocked to be the first. Her goals while serving on the board are to reach out to the petroleum engineering community and discuss the benefits of professional licensure. Cathy believes that the petroleum industry relies too greatly on the "industry exemption" for licensure, which says that if you are working for a company on their project/facilities, etc. then you do not have to be a licensed engineer. She believes industry exemption may get you through your entire career but if you want to consult and leverage your experience down the road you must be licensed.

Her favorite thing about being a petroleum engineer is that the learning never ends. To be a competent property evaluator Cathy must keep up with the latest in drilling, completion, land trends, geologic studies, and evaluation methodologies. She accomplishes this through networking, webinars, technical journals, and short courses. She says her time at Texas Tech not only provided her with the engineering knowledge she needed for her career, but the rigorous program taught her the mindset and work ethic required to tackle difficult engineering problems.

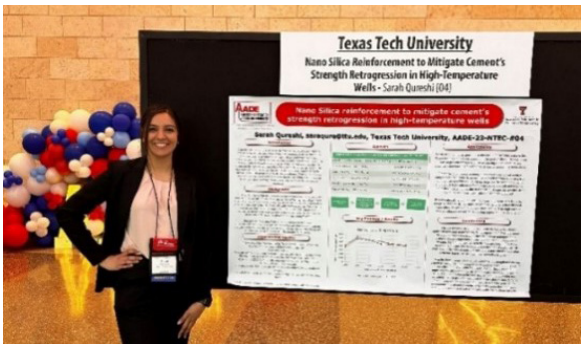
When thinking about the future, Cathy had some sage advice for current and future students in Petroleum Engineering. Cathy says, "Get involved with the department and SPE. Get to know your fellow classmates as they will eventually become your co-workers and valuable network. Also, take the FE exam around the time you graduate even if you think you will never need a license!"

Faculty Awards

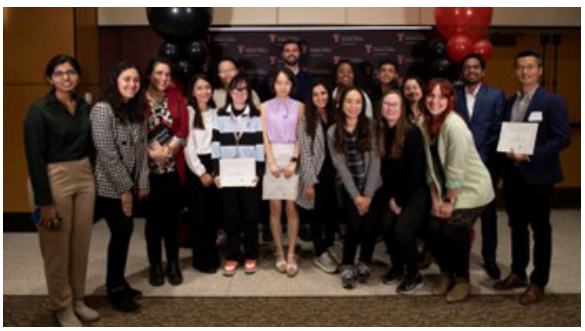
DR. QINGWANG (KEVIN) YUAN, Assistant Professor, won the Daneshy International Award for Best Invention on Energy Transition for his patent, entitled "In-situ hydrogen generation and production from petroleum reservoirs." He attended the E-CET Summit at the University of Southern California on March 20th, 2023, where he received the award. The E-CET Summit focuses on current efforts in Energy Transition and allows the opportunity to hear from executives and major consulting firms, networking, and learning about current research.

Student Awards

SARAH QURESHI, a senior Petroleum Engineering major, and internal vice president for the AADE Texas Tech Chapter, won first place at the 2023 AADE National Conference of Undergraduate Research Competition. Sarah's research was mentored through Dr. Hossein Emadi (associate professor), and Athar Hussain (Ph.D. Candidate and Research Assistant). The award was given for her poster and presentation on Nano Silica reinforcement to mitigate cement's strength retrogression in high-temperature wells.



KEJU YAN, a doctoral candidate, received the Graduate Research Support Award from the Graduate School at Texas Tech University. The Graduate Research Support Award provided by graduate school is to support graduate students' research with funding within 1,500 USD. With its help, Keju will buy lab materials like shale rocks, deuterium oxide, and catalysts, which will lead to more promising outcomes regarding in-situ hydrogen generation using catalytic microwave heating later this year. Keju is pictured below on the far right.



Upcoming SPE President Visits Texas Tech Campus

This past Spring, upcoming 2024 SPE President, and VP of Technology and Engineering at CARBO Ceramics, Terrence Palisch, visited the Petroleum Engineering department. Mr. Palisch gave a fantastic presentation and left our students with some valuable insights regarding leadership, networking, and the latest innovations with Carbo Ceramics.

We also want to say a huge thank you to the SPE Permian Basin Section. They awarded $112,000 in scholarships for the 2023-2024 academic school year, which is the highest amount ever awarded by the Permian Section. 21 of our incredible students were awarded through SPE. A huge congratulations to them as well.

Marshall Watson (left) and Terrence Palisch (right) visiting the drilling rig at the OTC

Student Organizations & Activities

AADE ATTENDS THE NATIONAL TECHNICAL CONFERENCE (MIDLAND, TX)

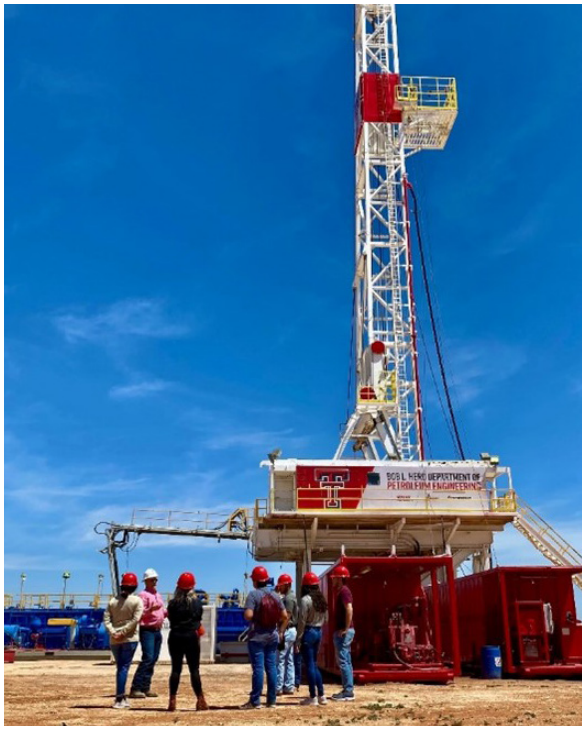
SPE CLAY SHOOTOUT

PETROLEUM AND GEOLOGY STUDENTS VISIT OKLAHOMA FOR FIELD TRIP

PE Hosts Biannual Roughneck Boot Camp with Record Turnout

Roughneck Boot Camp is a unique, hands-on experience for prospective and current students to learn about the equipment, procedures, safety, and the rig itself, but also receiving industry advice from professionals in the field, networking opportunities, and resume building ideas. October's Roughneck Boot Camp date to be determined.

Alum, Terry Fuller, discussing artificial lift with students at Roughneck Bootcamp



Alum, Tobin Scott, educating students on the workings of a drilling rig at the Texas Tech Oilfield Technology Center

Texas Tech University
Bob. L. Herd
Department of Petroleum Engineering
807 Boston Ave. | Room 210
Lubbock, Texas 79409

NAPE

Come join us this Spring, February 2024, at the NAPE Expo. The NAPE Expo is the energy industry's marketplace for the buying, selling, and trading of prospects and producing properties. Registration for 2024 NAPE Summit will open in late Summer 2023. Dr. Watson and some of our students will have a booth at the expo, so please drop by!

ATCE

Our department will also be hosting a booth at the Annual Technical Conference and Exhibition. Join us October 16-18, 2023 at the Henry B. Gonzalez Convention Center in San Antonio, Texas. The SPE ATCE is the leading technical energy conference and exhibition for global E&P professionals. Drop by booth 2053 to say hello to some familiar faces!

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