◎ 총 설

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2022년 펌프 및 수차 분야 연구동향

김성민*

1. 서 론

2022년 국내 펌프 및 수차 분야의 연구동향을 분석하기 위하여 2022년 한국유체기계학회 논문집과 한국유체기계학회 하계 및 동계 학술대회 발표논문 초록집에 발표된 논문을 조사하였다. 펌프 분야에서 53편, 수차 분야에서 21편, 펌프터빈 분야에서 4편의 논문이 발표되어 총 78편의 논문이 2022년에 발표되었다.

표 1은 펌프 및 수차 분야에서 발표된 논문을 분류 기준별로 정리한 것이며, 전년도 대비 펌프 분야의 논문 수는 증가하였고, 수차 분야의 논문 수는 감소하였으며, 펌프터빈 분야의 논문 수는 증가하였다. 펌프 분야에서는 펌프의 성능 및 효율향상과 최적설계 연구, 수차 분야에서는 중·대수력용 수차발전기 및 다양한 종류의 수차에 대한 성능시험 연구, 그리고 펌프터빈 분야에서는 양수발전소 펌프터빈의 운전성능 향상을 위한 연구가 활발히 수행되었다.

표 1 분류 기준 별 논문 수

분류 기준			논문 수 (편)
			2022년
펌프	논문집		4
	하계학술대회	일반세션	4
		특별세션	16
	동계학술대회	일반세션	10
		특별세션	19
수차	논문집		4
	하계학술대회	특별세션	8
	동계학술대회	일반세션	3
		특별세션	6
펌프터빈	하계학술대회	특별세션	2
	동계학술대회	특별세션	2
합계			78

2. 펌프 분야 관련 연구

펌프 분야에서는 산업용 펌프와 특수형 펌프 등 다양한 펌프들의 성능 및 효율 향상과 최적설계에 대한 연구가 수행되었다.

원심펌프[1~10]에 대해서는 펌프의 형상과 구조에 따른 유동 특성 및 운전 조건에 따른 성능 분석에 대한 연구와 스크류펌프, 다단 원심펌프에 대한 연구가 수행되었다. 사류펌프[11]에 대해서는 비속도 변화에 따른 설계사양 및 성능을 만족하는 임펠러 설계 기술에 관한 연구가 수행되었고, 축류펌프[12~25]에 대해서는 임펠러를 포함한 펌프 구성요소의 형상변화에 따른 성능 특성에 대한 연구가 진행되었다.

또한, 터보펌프[26~28], 단일채널펌프[29], 마이크로버블 펌프[30], 원자로 냉각재펌프[31] 순환펌프[32] 등의 특수펌프에 대해서도 성능향상을 위한 심도 있는 연구가 진행되었다. 수중펌프[33], LNG펌프[34], 부스터펌프[35~36], 슬러지펌프[37], 전기펌프[38], 헤더커버펌프[39], 생채모방공학을 이용한 펌프 임펠러 설계[40] 등 펌프에 대해 산업계 적용을 위한 연구도 수행되었다.

한편, 하계 및 동계 학술대회에 구성된 펌프 관련 특별세션[41~53]에서는 4차 산업시대의 펌프에 대한 기대, 문제점, 신기술 및 분석 기법이 소개되었다. 또한, 펌프의 고효율화 정책 및 기술개발 동향에 대한 다양한 연구와 형상 및 구조 변화에 따른 최적설계 등에 대한 심도 있는 연구가 발표되었다.

3. 수차 분야 관련 연구

수차 분야에서는 중·대수력용 수차발전기의 안정성 확보 및 성능향상을 위한 연구가 폭넓게 진행되었고, 모델수차의 성능시험 및 평가를 위한 시스템 개발 연구가 수행되었다.

프란시스수차[54~65]에 대해서는 중·대수력용 수차의 흡출관 내 형성되는 와류 특성에 대한 수치해석적 연구, 그리고 터빈 러너와 헤드커버의 진동 분석을 통해 수차의 효율 및 안정성 확보와 비속도에 따른 설계 변수에 관한 연구가 발표되었다.

* 성균관대학교 기계공학부(School of Mechanical Engineering, Sungkyunkwan University)
E-mail : smkim@skku.edu

또한 프란시스 수차의 흡입 헤드가 캐비테이션 발생에 미치는 영향 분석[66], 기계학습기법을 이용한 저낙차 수차의 성능 예측 연구[67] 등 프란시스 수차의 초기 설계 방법[68], 수차 러너의 개념설계 방법에 대한 연구[69]가 발표되었으며 또한, 중규모급 수력플랜트 연구과제물 설치 현안 사항[70]에 대해서도 발표되었다.

한편, 하계 및 동계 학술대회의 수차 관련 특별세션을 통해서도 많은 연구가 발표되었다. 텍스트 마이닝을 기반으로 국내외 수차 설비 상태 감시체계 현황[71]을 분석하였으며 데이터맵 기반 수차 설비 상태 감시 센서 위치 선정[72]에 관한 연구가 발표되었으며 또한, 수력발전소 유연화 운전 연구 개발의 동향[73], 화천 3호기 국산화 실증 수차발전기 기술 규격 검토[74]에 대한 연구가 발표되었다.

4. 펌프터빈 분야 관련 연구

펌프터빈 분야에서는 양수발전소 펌프터빈의 운전성능 향상 및 양수발전설비 운영기술에 관한 연구, 비속도 및 임펠러 형상에 따른 펌프터빈 성능 분석에 대한 연구가 진행되었다.

하계 및 동계 학술대회의 펌프터빈 관련 특별세션을 통해서도 연구가 발표되었다. 열역학법 시험을 통한 삼랑진 양수발전소 터빈 효율시험[75]에 대한 연구가 발표되었으며 "프랑스 Alstom社에서 설계하고 한국중공업(現 두산에너빌리티)에서 공급한 무주양수발전소"를 대상으로 외부 환경 변수에 따른 수차축 밀봉장치의 특성[76]에 관한 연구가 발표되었다. 또한 비속도에 따른 펌프수차 흡출관 선회류 거동[77]에 대한 연구 및 임펠러 형상에 따른 펌프수차 모델의 S 특성곡선에 미치는 영향[78]에 대한 연구가 발표되었다.

5. 결 론

2022년도 한국유체기계학회 논문집과 한국유체기계학회 하계 및 동계 학술대회에서 발표된 논문을 바탕으로 2022년 펌프, 수차, 그리고 펌프터빈 분야의 연구동향에 대해서 살펴보았다. 펌프 분야에서는 펌프의 설계인자들을 통한 성능 및 효율 향상과 최적설계에 대한 연구가 발표되었고, 여러 분야의 산업계 적용을 위해 다양한 종류의 특수펌프에 대한 연구도 다수 발표되었다. 수차 분야에서는 중·대수력용 수차발전기의 성능 및 효율향상과 안전성 확보를 위해 실험 및 수치해석적 연구가 수행되었다. 펌프터빈 분야에서는 양수발전설비의 운영기술 및 외부환경에 따른 수차축 밀봉장치의 특성 연구, 펌프수차의 임펠러 형상에 따른 성능 분석 및 향상에 관한 기초 및 심화연구가 수행됨을 확인할 수 있었다. 2023년에도 펌프 및 수차 분야의 지속적인 발전을 이루기 위해 관련된 기초 및 심화 연구가 활발히 진행되어 우수한 연구성과가 발표되기를 기대한다.

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